Nos. 23-2882, 23-2886, 23-3146

UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

CENTER FOR BIOLOGICAL DIVERSITY, et al.,
Plaintiffs-Appellees/Plaintiffs-Appellants,

and

ALLIANCE FOR THE WILD ROCKIES, et al.,
Plaintiffs-Appellees/Plaintiffs,

v.

UNITED STATES FOREST SERVICE, et al.,
Defendants-Appellants/Defendants/Defendants-Appellees,

and

KOOTENAI TRIBE OF IDAHO,
Intervenor-Defendant/Intervenor-Defendant-Appellant/
Intervenor Defendant-Appellee.

Appeal from the United States District Court for the District of Montana
No. 9:22-cv-114 (Hon. Donald W. Molloy)

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Appendix B. Secure Habitat Background

The Interagency Grizzly Bear Committee Taskforce Report on Grizzly bear/motorized access management was first released in 1994 and revised in 1998 (in their entirety: IGBC 1994, 1998). Management of motorized access is one of the most influential factors affecting habitat security for wildlife, including grizzly bears (Mattson *et al.* 1987; Mace and Manley 1993; USFWS 1993; Christensen *et al.* 1993). The Taskforce Report recognized that by managing motorized access, the following grizzly bear management objectives can be met (IGBC 1998, p. 1):

- Minimize human interactions and potential grizzly bear mortality;
- Minimize displacement from important habitats;
- Minimize habituation to humans; and
- Provide relatively secure habitat where energetic requirements can be met.

Historically, management of motorized use has been primarily accomplished through restriction of certain types of motorized use on established access routes. In addition to open and total road densities, the presence of core areas, areas free of motorized traffic and high levels of human use, are important to the management of human access (IGBC 1998, p. 1). The Taskforce Report recommended three parameters, with definitions and methods of measurement, to provide for a consistent approach to motorized access management between and within grizzly bear ecosystems: (1) open motorized route density (OMRD), (2) total motorized route density (TMRD), and (3) core areas (IGBC 1998, p. 1). Motorized route densities are calculated using a moving window analysis, and are reported as the percentage of the analysis area with greater than 1 mi/mi^2 open motorized routes and 2 mi/mi^2 total motorized routes. Core areas are reported as the percentage of the analysis area that are greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route and in place for at least 10 years. The Taskforce did not recommend minimum size for core areas. The Taskforce Report recognized that each ecosystem subcommittee would apply these recommendations based on ecosystem-specific information and recommend ecosystem specific habitat conditions that should be maintained to provide habitat security.

There is no published method to deductively calculate minimum habitat values required for a healthy and recovered population. Grizzly bears are long-lived, opportunistic omnivores whose food and space requirements vary depending on a multitude of environmental and behavioral conditions and on variation in the experience and knowledge of each individual bear. Grizzly bear home ranges overlap and change seasonally, annually, and with reproductive status. These characteristics make the development of habitat criteria complicated. We established criteria for the GYE and NCDE by assessing the habitat features that were compatible with a stable to increasing grizzly bear population in the past, and then used these habitat conditions as threshold values that must be maintained to ensure a healthy population (i.e., a "no net loss" or baseline approach), as suggested by Nielsen *et al.* (2006, p. 227). Because of the inability to calculate minimum habitat values for a recovered population, we use a "no net loss" approach by assessing what habitat factors are compatible with a stable to increasing grizzly bear population.

Greater Yellowstone Ecosystem (GYE)

The Service, in cooperation with the IGBC, held a workshop in 1997 to allow interested parties to present their ideas on the habitat needs for grizzly bear recovery and discuss proposals for habitat-based recovery criteria. Information gathered at the workshop was considered in drafting the habitat criteria for the Greater Yellowstone Area that were first released for public comment in 1999. These same criteria were included in the draft Conservation Strategy that was released for public comment in 2000. After analysis of public comment we developed the habitat standards in the 2007 Conservation and the Recovery Plan Supplement: Habitat-based Recovery Criteria for the Yellowstone Ecosystem.

The 1998 baseline for habitat standards was chosen because the levels of secure habitat and developed sites on public lands remained relatively constant in the 10 years preceding 1998 (USDA FS 2004, pp. 140–141), and the selection of 1998 ensured that habitat conditions existing at a time when the population was increasing at a rate of 4 to 7 percent per year (Schwartz *et al.* 2006b, p. 48) would be maintained. In addition to measures for motorized routes and secure core habitat, as recommended in the Taskforce Report, the baseline sets measures for developed recreation sites and livestock allotments. The overall habitat goal is to maintain habitat conditions at or improved upon baseline conditions, with limited exceptions as set forth in the YES Conservation Strategy (YES 2016a).

For the GYE, secure habitat refers to those areas with no motorized access that are at least 10 acres (0.31 km^2 (0.016 mi^2)) in size and more than 500 m (1,650 ft) from a motorized access route (open or gated) or recurring helicopter flight line (USDA FS 2004, p. 18). Our definition of secure habitat includes areas as small as 10 acres (0.31 km^2 (0.016 mi^2)) in size because both the IGBST and YES concluded that all secure habitats are important for grizzly bears in the GYE, regardless of size, particularly in peripheral areas. Research by Schwartz *et al.* (2010, p. 661) supported this conclusion and demonstrated a direct link between this definition and grizzly bear survival in the GYE. If the minimum size of secure habitat was enlarged, the end result would be that thousands of acres of secure habitat would no longer be considered secure and would, therefore, not be subject to the "no net loss" standard. By using a smaller minimum acreage requirement, we are not excluding any of the larger blocks of secure habitat. Non-motorized trails were not excluded from secure core because research indicates that non-motorized trails do not significantly affect grizzly bear survival, and that survival is better explained by the absence of motorized routes (Schwartz *et al.* 2010a, p. 659).

Northern Continental Divide Ecosystem (NCDE)

In a study of female grizzly bears in the South Fork of the Flathead River in the NCDE, female home ranges averaged 19 percent total road density >2 mi/mi^2, 19 percent open road density >1 mi/mi^2, and 68 percent core area (Manley 1993, *in litt.*). This level of secure core habitat was determined to be necessary for successfully reproducing adult female grizzly bears (Manley 1993, *in litt.*). As a result, Amendment 19 was used as a habitat management strategy for the Flathead National Forest (USFWS 1995, entire). Amendment 19 included no net increase in TMRD density greater than >2 mi/mi^2, no net increase in OMRD greater than >1 mi/mi^2, and no net decrease in the amount or size of security core. Furthermore, it established objectives: to

limit OMRD densities of >1 mi/mi^2 to no more than 19 percent of a BMU subunit; to limit TMRD densities of >2 mi/mi^2 to no more than 19 percent of a BMU subunit; and to provide security core areas that equal or exceed 60 percent of each BMU subunit in 5 years and 68 percent in 10 years.

Significant efforts made by the USFS led to the majority of the BMU subunits in the NCDE meeting the Amendment 19 objectives. Monitoring of the NCDE grizzly bear population show that the number of bears substantially exceed the minimum population size goal stated in the 1993 Recovery Plan (391 bears) (Service 1993, p. 62), the population is well distributed throughout the Recovery Zone, and the population has expanded its geographic distribution well beyond the Recovery Zone boundary (Kendall *et al.* 2009; Mace *et al.* 2012; Costello *et al.* 2016b), even though not every BMU subunit meets the 19-19-68 percentage objective of Amendment 19. Based on updated NCDE grizzly bear population data and our understanding about grizzly bear responses to human activities and management, in 2009, a Conservation Strategy Technical Team was appointed by the NCDE Subcommittee and began to re-evaluate habitat standards for the NCDE grizzly bear population. A draft Conservation Strategy was released in 2013 for public comment and peer review. The NCDE Subcommittee re-assembled the Conservation Strategy Team and finalized the Conservation Strategy in 2018. The NCDE Conservation Strategy is periodically revised for clarifications and corrections, with the most recent version published in 2020.

Based on an estimated growth rate for the NCDE grizzly bear population of 2–3 percent annually from 2004–2011, the NCDE Subcommittee decided to establish habitat conditions in December 31, 2011, as a reasonable and conservative baseline that would likely support a robust, stable to increasing grizzly bear population. In addition to measures for motorized routes and secure core habitat, as recommended in the Taskforce Report, the baseline sets measures for developed recreation sites and livestock allotments. The overall habitat goal is to maintain habitat conditions at or improved upon baseline conditions, with limited exceptions as set forth in the NCDE Conservation Strategy (NCDE Subcommittee 2020)

For the NCDE, secure core habitat is defined as those areas on Federal lands within the analysis area more than 500 m (1,650 ft) from a motorized access route and at least 2,500 acres (10.1 km^2 (3.9 mi^2)) in size, and in place for 10 years (Service 2018, pp. 5, 12). The 2,500 acre (10.1 km^2 (3.9 mi^2)) minimum size for secure core habitat is based on the 1994 IGBC Guidelines that state minimum size will be recovery zone specific and that "the minimum size for the core area(s) be that area necessary to support a female grizzly bear for 24 hours of foraging." Information and research specific to the NCDE indicated that 83 percent of documented locations of radio-collared females were in habitat that did not have motorized access that were usually at least 2,200 acres in size (USFWS 1997). Non-motorized trails were not excluded from secure core because research indicates that non-motorized trails do not significantly affect grizzly bear survival, and that survival was better explained by the absence of motorized routes (Schwartz *et al*. 2010a, p. 659).

Cabinet-Yaak (CYE) and Selkirk Ecosystems (SE)

Wakkinen and Kasworm (1997, entire) created road density and core area maps for the CYE and SE based on the definitions set forth in the Taskforce Report. Based on female grizzly bear radiotelemetry data, they determined the proportion of home ranges with greater than 2 mi/mi^2 total road density, greater than 1 mi/mi^2 open road density, and the amount of core area are appropriate access management standards for the CYE and SE (Wakkinen and Kasworm 1997, p. 22). The female home ranges averaged 26 percent total road density greater than 2 mi/mi^2, 33 percent open road density greater than 1 mi/mi^2, and 55 percent core area. No minimum core area size was determined because of the small sample size (Wakkinen and Kasworm 1997, p. 23). Wakkinen and Kasworm (1997, pp. 24–25) speculated that differences in the percentage of core areas within home ranges between the NCDE and the CYE and SE may be due to the lack of larger core areas available in the CYE and SE, different computer software to conduct the analysis, and/or differences in levels of human use on roads between the ecosystems. The recommendations by Wakkinen and Kasworm (1997, pp. 24–25) for OMRD, TMRD, and core area were incorporated into the Forest Plan Amendments for the Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones (USDA FS 2011b, entire).

North Cascades Ecosystem

Core areas for the North Cascades are defined as those areas greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route, as set forth by the Taskforce Report (USDA FS 1997, entire). The North Cascades Ecosystem Subcommittee agreed to a phased approach to identify and protect “core area” (USDA FS 1997, p. 1). The Federal land management agencies agreed to manage for “no net loss” of core area until “seasonal habitat has been defined, mapped and its availability evaluated” (USDA FS 1997, p. 3). In addition, they identified the need to do further work to define “high use non-motorized trails” for the North Cascades (USDA FS 1997, p. 1).

Bitterroot Ecosystem (BE)

Ecosystem specific data are not available, and motorized access and core area standards have not yet developed for the BE.

Appendix C. Suitable Habitat in the GYE

For the purposes of this biological report, "suitable habitat" is considered the area within the larger GYE ecosystem capable of supporting grizzly bear reproduction and survival now and in the future. Suitable habitat is generally associated with mountains and forested lands that are primarily owned and managed by Federal agencies. We defined "suitable habitat" for grizzly bears as areas having three characteristics:

(1) Being of adequate habitat quality and quantity to support grizzly bear reproduction and survival;
(2) Being contiguous with the current distribution of GYE grizzly bears such that natural recolonization is possible; and
(3) Having low mortality risk as indicated through reasonable and manageable levels of grizzly bear mortality.

Our definition and delineation of suitable habitat is built on the widely accepted conclusions of extensive research that grizzly bear reproduction and survival is a function of both the biological needs of grizzly bears and remoteness from human activities, which minimizes mortality risk for grizzly bears (Craighead 1980, pp. 8–11; Knight 1980, pp. 1–3; Peek *et al.* 1987, pp. 160–161; Merrill *et al.* 1999, pp. 233–235; Schwartz *et al.* 2010a, p. 661).

Our first criteria in defining suitable habitat involved analyzing land cover types. Mountainous areas provide hiding cover, the topographic variation necessary to ensure a wide variety of seasonal foods, and the steep slopes used for denning (Judd *et al.* 1986, pp. 114–115; Aune and Kasworm 1989, pp. 29–58; Linnell *et al.* 2000, pp. 403–405). Higher elevation, mountainous regions in the GYE (Omernik 1987, pp. 118–125; Omernik 1995, pp. 49–62; Woods *et al.* 1999, entire; McGrath *et al.* 2002, entire; Chapman *et al.* 2004, entire) contain high-energy foods such as whitebark pine seeds (Mattson and Jonkel 1990, p. 223; Mattson *et al.* 1991*a*, p. 1623) and army cutworm moths (Mattson *et al.* 1991*b*, 2434; French *et al.* 1994, p. 391). For our analysis of suitable habitat, we considered the Middle Rockies ecoregion, within which the GYE is contained (Omernik 1987, pp. 120–121; Woods *et al.* 1999, entire; McGrath *et al.* 2002, entire; Chapman *et al.* 2004, entire), to meet grizzly bear biological needs providing food, seasonal foraging opportunities, cover, and denning areas (Mattson and Merrill 2002, p. 1125).

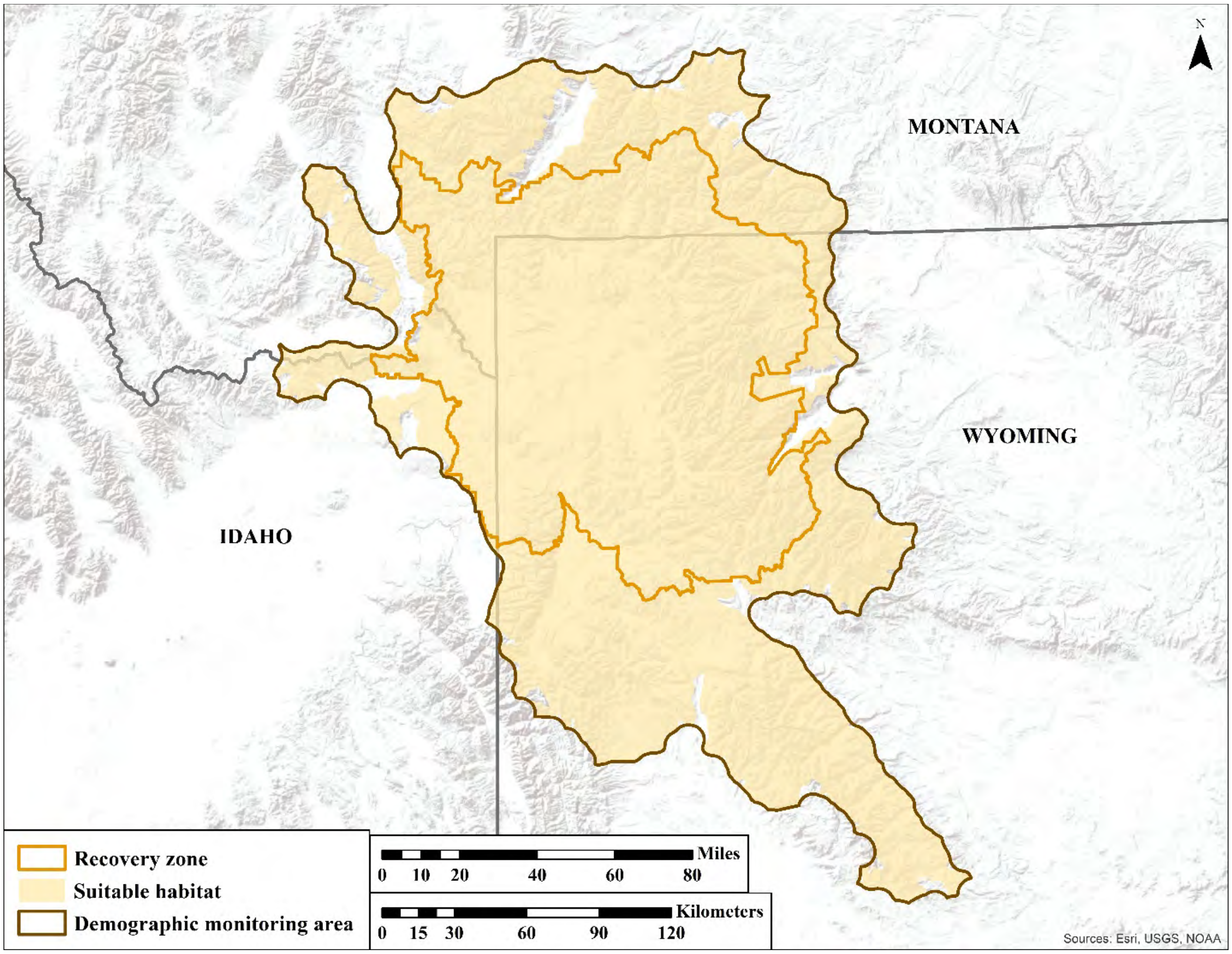

Figure 1. Map of the Greater Yellowstone Ecosystem (GYE). Boundaries are shown for: (1) the recovery zone; (2) the Demographic Monitoring Area; and (3) biologically suitable habitat.

Although grizzly bears historically occurred throughout the area of the larger GYE ecosystem (Stebler 1972, pp. 297–298), today many of these habitats are not biologically suitable for grizzly bears. For example, we did not include drier sagebrush, prairie, or agricultural lands within our definition of suitable habitat because these land types no longer contain adequate food resources (i.e., bison) to support grizzly bears. While there are records of grizzly bears in eastern Wyoming near present-day Sheridan, Casper, and Wheatland, even in the early 19th century, indirect evidence suggests that grizzly bears were less common in these eastern prairie habitats than in mountainous areas to the west (Rollins 1935, p. 191; Wade 1947, p. 444). Grizzly bear presence in drier, grassland habitats was associated with rivers and streams where grizzly bears used bison carcasses as a major food source (Burroughs 1961, pp. 57–60; Herrero 1972, pp. 224–227; Stebler 1972, pp. 297–298; Mattson and Merrill 2002, pp. 1128–1129). Most of the short-grass prairie on the east side of the Rocky Mountains has been converted into agricultural land (Woods *et al.* 1999, entire), and high densities of traditional food sources are no longer available due to land conversion and human occupancy of urban and rural lands. Traditional food sources such as bison and elk have been reduced and replaced with domestic livestock such as cattle, sheep, chickens, goats, pigs, and bee hives, which can become anthropogenic sources of prey for grizzly bears. While food sources such as grasses and berries are abundant in some years in the riparian zones within which the bears travel, these are not reliable every year and can only

support a small number of bears. These nutritional constraints and the potential for human-bear conflicts limit the potential for a self-sustaining population of grizzly bears to develop in the prairies, although we expect some grizzly bears to live in these areas. Because wild bison herds no longer exist in these areas, and are mainly contained within YNP in the GYE, they are no longer capable of contributing in a meaningful way to the overall status of the GYE grizzly bear.

Bears in these peripheral areas (i.e., prairie habitats) will not establish self-sustaining, year-round populations due to a lack of suitable habitat, land ownership patterns, and the lack of traditional, natural grizzly bear foods (i.e., bison). Instead, bears in these peripheral areas will likely always rely on the GYE grizzly bear population inside the DMA as a source population. Grizzly bears in these peripheral areas are not biologically necessary to the GYE grizzly bear population and a lack of occupancy outside the DMA boundaries in peripheral areas will not impact the resiliency of the GYE grizzly bear population. Grizzly bear recovery in these portions of the species' historical range is unnecessary, because there is more than enough suitable habitat to support a viable grizzly bear population as set forth in the demographic recovery criteria.

Our second criteria in defining suitable habitat involved analyzing human-caused mortality risk, as this can impact which habitat might be considered suitable. Some human-caused mortality is unavoidable in a dynamic system where hundreds of bears inhabit large areas of diverse habitat with several million human visitors and residents. The negative impacts of humans on grizzly bear survival and habitat use are well documented (Harding and Nagy 1980, p. 278; McLellan and Shackleton 1988, pp. 458–459; Aune and Kasworm 1989, pp. 83–103; McLellan 1989, pp. 1862–1864; McLellan and Shackleton 1989b, pp. 377–378; Mattson 1990, pp. 41–44; Mattson and Knight 1991, pp. 9–11; Mace *et al.* 1996, p. 1403; McLellan *et al.* 1999, pp. 914–916; White *et al.* 1999, p. 150; Woodroffe 2000, pp. 166–168; Boyce *et al.* 2001, p. 34; Johnson *et al.* 2004, p. 976; Schwartz *et al.* 2010a, p. 661). These effects range from temporary displacement to actual mortality. Grizzly bear persistence in the contiguous United States between 1920 and 2000 was negatively associated with human and livestock densities (Mattson and Merrill 2002, pp. 1129–1134).

As human population densities increase, the frequency of encounters between humans and grizzly bears also increases, resulting in more human-caused grizzly bear mortalities due to a perceived or real threat to human life or property (Mattson *et al.* 1996, pp. 1014–1015). Similarly, as livestock densities increase in habitat occupied by grizzly bears, depredations follow. Although grizzly bears frequently coexist with cattle without depredating them, when grizzly bears encounter domestic sheep, they usually are attracted to such flocks and depredate the sheep (Jonkel 1980, p. 12; Knight and Judd 1983, pp. 188–189; Orme and Williams 1986, pp. 199–202; Anderson *et al.* 2002, pp. 252–253). If repeated depredations occur, managers either relocate the bear or remove it (i.e., euthanize or place in an approved American Zoological Association facility) from the population, resulting in such domestic sheep areas becoming population sinks (areas where death rates exceed birth rates) (Knight *et al.* 1988, pp. 122–123). Because urban sites and sheep allotments possess high mortality risks for grizzly bears, we did not include these areas as suitable habitat (Knight *et al.* 1988, pp. 122–123). Based on 2000 census data, we defined urban areas as census blocks with human population densities of more than 50 people per km^2 (129 people per mi^2) (U.S. Census Bureau 2005, entire). Cities within the Middle Rockies ecoregion, such as West Yellowstone, Gardiner, Big Sky, and Cooke City,

Montana, and Jackson, Wyoming, were not included as suitable habitat. There are large, contiguous blocks of sheep allotments in peripheral areas of the ecosystem in the Wyoming Mountain Range, the Salt River Mountain Range, and portions of the Wind River Mountain Range on the Bridger Teton and the Targhee NFs (see Figure 1 in *Appendix C*).

This spatial distribution of sheep allotments on the periphery of suitable habitat results in areas of high mortality risk to bears within these allotments and a few small, isolated patches or strips of suitable habitat adjacent to or within sheep allotments. Due to the negative "edge effects" of this distribution of sheep allotments on the periphery of current grizzly bear range, our analysis did not classify linear strips and isolated patches of habitat as suitable habitat. These strips and patches of land possess higher mortality risks for grizzly bears because of their enclosure by and/or proximity to areas of high mortality risk. This phenomenon in which the quantity and quality of suitable habitat is diminished because of interactions with surrounding less suitable habitat is known as an edge effect (Lande 1988, pp. 3–4; Yahner 1988, pp. 335–337; Mills 1995, p. 396). Edge effects are exacerbated in small habitat patches with high perimeter-to-area ratios (i.e., those that are longer and narrower) and in wide-ranging species such as grizzly bears because they are more likely to encounter surrounding, unsuitable habitat (Woodroffe and Ginsberg 1998, p. 2126).

Finally, dispersal capabilities of grizzly bears were considered in our determination of which potential habitat areas might be considered suitable. For example, because the Bighorn mountain range is disjunct from other suitable habitat and current grizzly bear distribution, our analysis did not classify the Bighorn Mountains as suitable habitat within the GYE. The Bighorn Mountains comprise 6,341 km^2 (2,448 mi^2) of habitat that is classified as part of the Middle Rockies ecoregion, but are separated from the current grizzly bear distribution by approximately 100 km (60 mi) of a mosaic of private and BLM lands primarily used for agriculture, livestock grazing, and oil and gas production (Chapman *et al.* 2004, entire). Although there is a possibility that individual bears may emigrate from the GYE to the Bighorn Mountains occasionally, this dispersal distance exceeds the average dispersal distance for both males (30 to 42 km (19 to 26 mi)) and females (10 to 14 km (6 to 9 mi)) (McLellan and Hovey 2001, p. 842; Proctor *et al.* 2004, p. 1108). Without constant emigrants from suitable habitat, the Bighorn Mountains will not support a self-sustaining grizzly bear population.

Some areas that do not meet our definition of suitable habitat may still be used by grizzly bears (Schwartz *et al.* 2002, p. 209; Schwartz *et al.* 2006b, pp. 64–66). The records of grizzly bears in these unsuitable habitat areas are generally due to recorded human-grizzly bear conflicts or to transient animals. These areas are defined as unsuitable due to the high risk of mortality resulting from these human-grizzly bear conflicts. These unsuitable habitat areas may contain grizzly bears but do not support grizzly bear reproduction or survival because bears that repeatedly come into conflict with humans or livestock are usually either relocated or removed from these areas.

According to the criteria in defining suitable habitat, the GYE contains approximately 46,905 km^2 (18,110 mi^2) of suitable grizzly bear habitat (Figure 38). The Service concluded that this amount of suitable habitat is sufficient to meet all habitat needs of a recovered grizzly bear population and provide ecological resiliency to the population through the availability of widely

distributed, high-quality habitat that will allow the population to respond to environmental changes.

Appendix D. Methods Used to Measure Population Trends and Annual Estimates

Wildlife managers and population ecologists monitor a number of factors to gauge the status of a population and make scientifically informed decisions. These measures include population size, population trend, density, and current range. While population size is a well-known and easily understood metric, it only provides information about a population at a single point in time. Wildlife managers often want to know how a population is changing over time and why. As managers and technical experts review new techniques or approaches for potential adoption, they should consider the technique's cost, field sampling logistics, utility to managers, and the ability to retroactively apply population estimates to previous years of data are considered.

Greater Yellowstone Ecosystem (GYE)

The IGBST uses four independent methods to estimate population trend: (1) the model-averaged Chao2 method, which is also used to estimate population size; (2) Mark-Resight estimator (i.e., capture-recapture data (IGBST annual reports)); (3) population projections from known-fate analysis (in their entirety: Schwartz *et al*. 2006b; IGBST 2012); and (4) population reconstruction (minimum number of known live) based on capture and mortality records (IGBST, unpublished data). The IGBST's goal is to maintain a minimum of 25 adult female grizzly bears fitted with radio collars and a similar sample of males spatially distributed throughout the ecosystem.

Model-Averaged Chao2 Population Estimator

The model-averaged Chao2 population estimator is currently the best available science to derive annual estimates of total population size in the GYE. The basis for the estimation is an annual count of female grizzly bears with cubs-of-the-year, based on sightings on aerial surveys and ground observations. Those sightings are clustered into those estimated to be from the same family group (i.e., female with cubs-of-the-year) using a "rule set" to avoid duplicate counts, primarily based on spatial, temporal, and litter size criteria (Knight *et al.* 1995). In clustering the observations, a balance must be obtained between overestimating or underestimating the actual number of unique females with cubs-of-the-year. The rule set was constructed to be conservative (i.e., reduce Type I errors or mistakenly identifying sightings of the same family as different families). Using the frequencies of sightings of unique females with cubs-of-the-year obtained from application of the rule set, an annual estimate of the total number of females with cubs-of-the-year is calculated using the Chao2 estimator, a bias-corrected estimator that is robust to differences in sighting probabilities among individuals (Chao 1989; Keating *et al.* 2002; Cherry *et al.* 2007). In the final step, the annual estimate of total number of females with cubs-of-the-year is combined with those of previous years to assess trend. Changes in numbers of females with cubs-of-the-year are representative of the rate of change for the entire population, but additional process variation comes from the proportion of females that have cubs-of-the-year.

Annual estimates of females with cubs-of-the-year based on Chao2 have been reported by IGBST since 2005, accompanied by the derivation of total population estimates. The model-

averaged Chao2 estimates of females with cubs-of-the-year and derived total population estimates have been applied and reported by the IGBST since 2007.

Other Methods

The known-fate analysis method is the IGBST's primary method for estimating population trend. The known-fate analysis method uses estimates of vital rates derived from radio-monitoring a representative sample of grizzly bears in the GYE (e.g., see Schwartz *et al*. 2006b; IGBST 2012). Those vital rates include annual survival rates for independent male and female grizzly bears, age of first reproduction, litter size, and survival of dependent young (i.e., cubs of the year and yearlings) that accompany their radio-marked mothers. The estimated number of unique females with cubs-of-the-year used in the Chao2 method do not enter into those population projections and thus represent an independent data source. However, IGBST can also estimate trend using the Chao2-corrected annual counts of unique females with cubs. Although not a primary IGBST method for assessing trend, the trend for this observable segment of the population (i.e., females with cubs-of-the-year) is representative of trend for the entire population.

In order to derive an annual population estimate (rather than calculation of population trend), the IGBST uses both the end point for the model-averaged result of the linear and quadratic regressions of the Chao2-corrected counts, combined with vital rates estimates from the known-fate analyses (see IGBST 2012, p. 39).

Northern Continental Divide Ecosystem (NCDE)

In the NCDE, the population trend is estimated using two methods: (1) a deterministic life table analysis; and (2) individual-based, stochastic population modeling (Costello *et al.* 2016b, p. 69). The population estimate is based on a genetic capture/recapture study conducted in 2004 (Kendall *et al.* 2009, entire) and subsequent estimates of population trend (Costello *et al.* 2016b, p. 16). MFWP's goal is to maintain a minimum of 25 adult female grizzly bears fitted with radio collars and collar males as resources allow, with a goal of five of males, spatially distributed throughout the ecosystem.

Deterministic Life Table Analysis

The deterministic life-table analysis approach involves estimates of vital rates, does not incorporate uncertainty, and is a female-only rate. It computes the deterministic asymptomatic rate of population growth (lambda; λ) using a standard, dynamic life table and solving iteratively for r (i.e., the intrinsic rate of growth). Costello *et al.* (2016b, p. 69) estimated λ using "three point estimates of independent female survival: (1) maximum (0.951), obtained when unknown-fate females were censured; (2) minimum (0.943), obtained when unknown-fate females were assumed dead; and (3) the mean of those two estimates (0.947)."

Individual-based, Stochastic Population Modeling

Individual-based, stochastic population modeling is based on vital rates of all sex/age classes and the uncertainty associated with each vital rate. This estimate uses RISKMAN to stochastically

model population growth based on estimated recruitment rates, dependent bear survival rates, and independent bear survival rates for both males and females (Costello *et al.* 2016b, p. 69).

Genetic Capture/Recapture Population Estimate

In 2004, a noninvasive genetic sampling effort was conducted within occupied areas of the NCDE (Kendall *et al.* 2009, entire). DNA data was included from hair traps, bear rubs, and physical captures to construct individual bear encounter histories in a Huggins-Pledger closed mark-recapture model to estimate population size. Lured hair traps were systematically distributed using a grid of 7x7 km cells across estimated occupied areas. Placement of the hair snare within each cell was based on evidence of bear activity, presence of natural travel routes, seasonal vegetation characteristics, and indices of recent wildfire severity. Bears naturally rub on trees, power poles, wooden signs and fence posts, and barbed wire fences, and thus did not require the use of lure. Physical capture information included bears handled for research or management or that were identified during other hair sampling studies from 1975-2007.

Cabinet-Yaak and Selkirk Ecosystems (CYE and SE)

In the CYE and SE the population trend is determined by female survival and fecundity rates determined through radio collar monitoring (Kasworm *et al.* 2020a, pp. 38–40, Kasworm *et al.* 2020b, pp. 26–27). Due to the small population sizes in the CYE and SE, the Service attempts to collar as many females and males as possible. Bootstrapping techniques are used to estimate lambda and associated confidence intervals (Hovey and McLellan 1996, entire).

Annual CYE population estimates are obtained by applying the rate of growth to a 2012 population estimate (Kasworm *et al* 2020a, p. 40). The 2012 estimate was developed from a mark-recapture effort using hair traps and rub trees (Kendall *et al*. 2016, entire). Kasworm *et al.* (2020a, p. 29) also estimate a minimum number of individuals identified in annual collared bear monitoring, captures, hair sampling, and trail camera photographs, minus any known mortality.

In the SE, population estimates are obtained by applying the rate of growth to a 2002 population estimate (Kasworm *et al.* 2020b, pp. 26-27). The 2002 estimate was developed from a mark recapture effort using hair corrals in the B.C. portion of the SE in 2002 (Proctor *et al.* 2007, p. 3). Kasworm *et al*. (2020b, p. 19) also estimate a minimum number of individuals identified in annual collared bear monitoring, captures, hair sampling, and trail camera photographs, minus any known mortality.

The 1993 Recovery Plan details a method to calculate a minimum population estimate based on a 6-year average of unduplicated females with cubs to stabilize the averaged based on a 3-year reproductive cycle. The 6-year average of females with cubs is multiplied by three to estimate the number of adult females in the population given that on average, either 28 percent (CYE) or 33 percent (SE) of the population is made of adult females. The minimum number of females with cubs likely underestimates the actual number because reporting efficiency of females with cubs is estimated to be 60 percent. The proportion of adult females in the population is based on the proportion adults to subadults in the population and the sex ratio of males to females for both subadults and adults. The minimum population size is calculated by dividing 6-year average

observed females with cubs by 0.6 then dividing by the adult female proportion of the population (Service 1993, pp. 83–84, 101–102; Kasworm *et al.* 2020a, p. 16.; Kasworm *et al.* 2020b, pp. 12–13).

Appendix E. Canadian Grizzly Bear Assessment

Assessment of grizzly bears (*Ursus arctos*) north of the Canada-U.S. border and their relationship to populations in the lower-48 States

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Introduction

Grizzly bears in Canada are designated nationally as 'Special Concern' by the Canadian Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the federal Species at Risk Act. This designation was made due to the bear's North American population decline over the past 150 years, its sensitivity to human disturbance and human-caused mortality, poor population data across its range, a few local population declines, and extensive fragmentation in the southern portion of its Canadian range (COSEWIC 2012). However, there is evidence of a stable population overall across their distribution in Canada (COSEWIC 2012). There are approximately 15,000 grizzly bears in British Columbia (B.C.), 700 in Alberta, and 13,000 north of the 60th parallel in the Yukon, Northwest Territories, and Nunavut (Figure 1). While bears live within generally large robust populations in northern portions of the provinces, their populations along the periphery of their distribution in Alberta and along the Canada-U.S. border have varying levels of conservation concern (McLellan 1998). This concern is dominated by fragmentation creating smaller populations, conflict related mortality on their periphery in the human-settled valleys of this mountainous landscape, and by backcountry mortalities related to motorized access. In contrast to the grizzly bear conservation status in the lower-48 States where their threatened status under the federal Endangered Species Act affords them significant protection and resources for conservation management, the circumstances within Canada have not resulted in a similar level of conservation concern for grizzly bears. Thus, the overall conservation management is considerably less. Also, grizzly bear management is the realm of the Provinces. Grizzly bear conservation and management within B.C. is guided by the Wildlife Act and B.C.'s Conservation Strategy. Similarly, in Alberta, a provincial grizzly bear recovery plan provides the basis for bear conservation and management (Alberta Environment and Parks 2016).

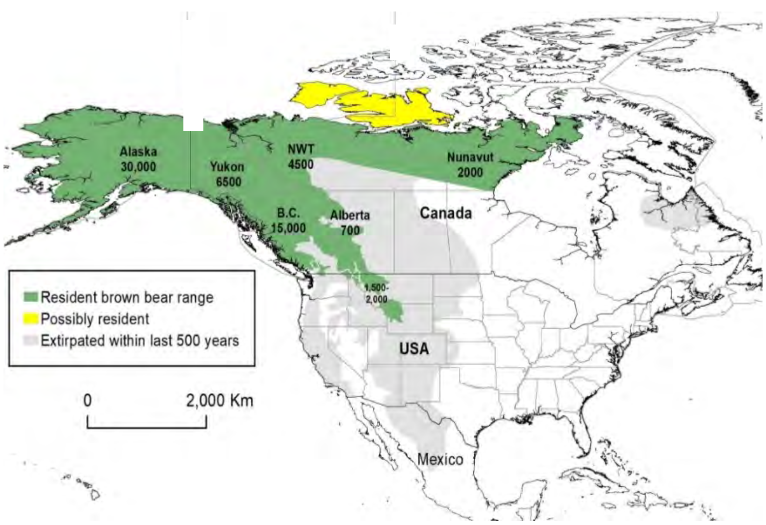

Figure 1: Grizzly bear distribution in western North America with abundance estimates. Adapted from Proctor et al. (2021a).

The main benefit of Canadian grizzly bears to those in the lower-48 States is the provision of genetic and demographic connectivity. Here we speak of connectivity in terms of movements between areas that are accompanied by breeding. Genetic connectivity resists losses of genetic diversity that usually occur in small, isolated populations and is more easily mediated by more vagile males (Proctor *et al.* 2005). Demographic connectivity offers a 'rescue' effect for small, isolated populations that may lose females (and reproductive capacity) through stochastic (chance) events (e.g., disease) or through more deterministic process (e.g., excessive human-caused mortality on the periphery of small populations) (Proctor *et al.* 2012, Lamb *et al.* 2016). For example, the international South Selkirk population had been totally isolated for decades (Proctor *et al.* 2005, 2012), but is currently experiencing increased connectivity and has been for the past decade (Proctor *et al.* 2018). This population's best opportunity for genetic and demographic connectivity from a larger healthier population occurs with the south Purcell Mountains of southern B.C. across the Creston Valley and B.C. Highway 3A (just north of Bonners Ferry, Id). This same Purcell Mountain grizzly population is the nearest population to reconnect the international Yahk/Yaak population. In fact, males have remained partially connected across B.C Highway 3 into the Yahk/Yaak population, mediating genetic connectivity, but demographic connectivity has been lacking (Proctor *et al.* 2005, 2012).

Additionally, B.C. and Alberta combined have many more bears than are in the lower-48 States, particularly B.C. (Figure 1), which until recently, allowed a decades-long sustainable grizzly bear hunt (McLellan *et al.* 2017a). In 2017, the B.C. grizzly bear hunt was halted on ethical grounds and public opposition, not conservation concern. This fundamental difference between bear populations in B.C and the lower-48 States has resulted in a difference in intensity of conservation management between the two jurisdictions. However, many of the conservation challenges present in the lower-48 States are also present in Canada, particularly for bear populations along the Canada-U.S. border. Fragmentation from human settlement patterns, human-caused mortality, and traffic on major highways has created small, fragmented or isolated threatened populations in the lower-48 States (i.e., the South Selkirk, Yaak, and Cabinets populations, Proctor *et al.* 2012). Canadian Highway 3, just north of the U.S.-Canada border, and its associated settlement is responsible for much of the fragmentation of Canadian bear populations and separates these trans-border populations from the larger Canadian grizzly bear populations to the north (Proctor *et al.* 2005). In that regard, there has been much research and conservation effort to reverse this fragmentation within Canada and some measure of success to date. A large network of government agencies, Environmental Non-government Organizations (ENGOs), and public interest groups from both countries are beginning to work cooperatively to solve this problem.

The other area of enduring conservation management in Canada is the challenge the provinces have with motorized access management, an important tool in grizzly bear conservation management (Proctor *et al.* 2020). While there have been local motorized access management plans initiated, some successfully, they have been a challenge to implement more broadly.

Here we review the research, management, conservation progress, and status of grizzly bear populations in British Columbia and Alberta, Canada with a focus on those just north of the 49th parallel. We briefly provide an overview of bear populations further north.

British Columbia Overview

Most (~80 percent) of British Columbia (B.C.) is grizzly bear habitat; grizzly bears were extirpated due to human settlement associated with excessive human-caused mortality over the past century from the lower mainland around the metropolis of Vancouver, south-central Okanagan valley, and a small corner in northeastern B.C. (Figure 1). Going north in B.C, the influence of humans decreases, and grizzly bears flourish. B.C. covers ~950,000 km^2 and grizzly bears occupy ~750,000 km^2. In contrast, in the lower-48 States, grizzly bears occupy a much smaller area of approximately 55,000 km^2. The ecology of B.C. is incredibly varied from moist mountainous forests in the east, to the semi-desert Okanagan in the dry central interior, to very wet coastal mountain forests in the west; grizzly bear habitat productivity also varies over this range (Mowat *et al*. 2013).

Grizzly bears were intentionally killed in B.C. during European settlement into the early 1900s' (McLellan 1998), and hunting went unregulated until the late 1960s when spring and fall hunts were initiated. In the mid-1970s, a Limited Entry Hunt (LEH) was instigated in the southern portion of the province (Peek *et al.* 2003). B.C. adopted a grizzly bear Conservation Strategy in 1995 (B.C. Conservation Strategy 1995), and in 1996 the LEH was extended to the entire province with limits on the numbers of females taken (Peek *et al.* 2003). With a few localized exceptions, the hunt was then sustainable for decades after the LEH was applied (McLellan *et al.* 2017a, Hatter *et al.* 2018), although concerns have been raised (Artelle *et al.* 2013). The biggest challenges in managing for an accurate sustainable mortality rate, were the inability to estimate the grizzly bear population across the province accurately and to account for unreported mortalities. After the DNA survey method was developed in 1995 (Proctor 1995, Woods *et al.* 1999), reliable population estimates were carried out over portions of the province and unreported mortality was estimated from telemetry research and hunting quotas were assessed and adjusted accordingly. In 2017, the legal hunt was halted due to public opposition, although First Nations are allowed to hunt for food, social, or ceremonial reasons (https://news.gov.bc.ca/releases/2017FLNR0372-002065). It is also legal to kill a grizzly bear in defense of life or property.

The current estimated grizzly bear population in B.C. is ~15,000, and bear densities vary from less than 10 to greater than 400 bears/1,000 km^2 (Mowat *et al.* 2013). Provincially, grizzly bears are ranked as 'Special Concern' by the B.C Conservation Data Center and federally under the Species at Risk Act (COSEWIC 2012, SARA 2018). While grizzly bears are internationally designated as 'Least Concern' by the IUCN Red List of Threatened Species, four populations within B.C were designated as 'Threatened', 3 of which span the Canada-U.S. border (North Cascades-Critically Endangered, South Selkirk-Vulnerable, and the Yahk/Yaak-Endangered) (McLellan *et al.* 2017b).

B.C.'s estimated 15,000 grizzly bears (B.C Min. FLNRORD 2020) are managed through 55 Grizzly Bear Population Units (GBPU), which were formed with natural and anthropogenic boundaries in mind (Figure 2a). Originally GBPUs were ranked as 'threatened', viable' or 'extirpated' based on the perceived relationship between their current bear numbers and their potential 'carrying capacity' (Austin and Hamilton 2004). This system was replaced recently by a more measurable, objective method based on principles developed by the IUCN and

implemented by a Nature Serve–based system of conservation ranking (Figure 2a, Morgan *et al.* 2020). Current rankings span 5 categories M1 – M5 with the highest level of conservation concern in units labelled M1. The IUCN and Nature Serve labels are primarily designed to assess extinction risk, but because most GBPUs in B.C. are jurisdictional units that are often inter-connected with neighbouring units and not biologically isolated populations, their extinction risk is generally very low. For this reason, the B.C. government refers to their status with relative descriptors of 'conservation concern' M1 – M5. This applies to all of B.C.s GBPUs except a few that are biologically isolated or intensely fragmented and are separately designated by the IUCN Red List Assessment process as mentioned above (McLellan *et al.* 2017b).

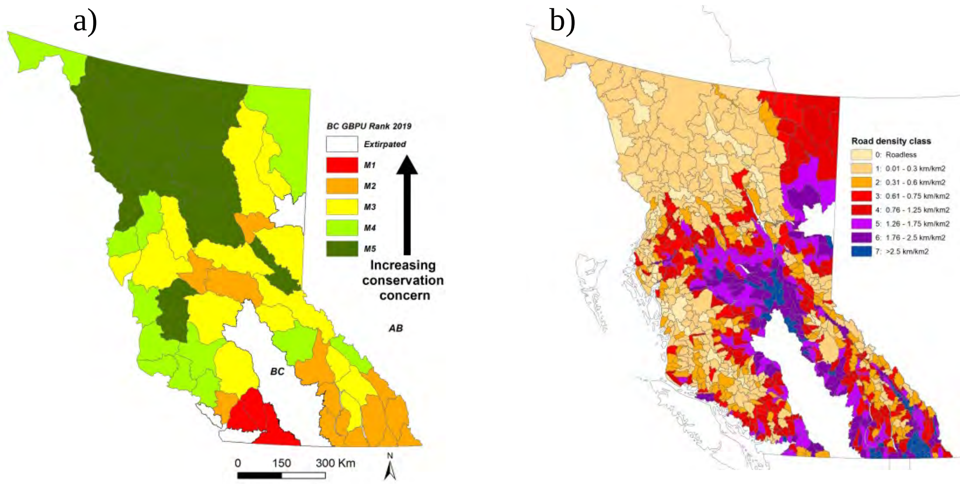

Figure 2: a) Grizzly Bear Population Units across B.C. ranked for conservation status using the Nature Serve threats assessment protocols (Morgan et al. 2020) and, b) road density by landscape unit across British Columbia (Adapted from Proctor et al. 2020).

The 1995 Grizzly Bear Conservation Strategy declared that B.C.'s grizzly bears would be managed to "maintain in perpetuity the diversity and abundance of Grizzly bears and the ecosystems on which they depend throughout British Columbia" and "to improve the management of Grizzly bears and their interactions with humans." In 2016, the B.C. Ministries of Environment and Climate Change Strategy and Forests, Lands, and Natural Resource Operations and Rural Development (FLNRORD) updated that commitment with 3 objectives:

1. Ensure Grizzly bear populations are sustainable, including managing for genetic and demographic linkage;
2. Continue to manage lands and resources for the provision of sustainable Grizzly bear viewing opportunities; and
3. Where appropriate, restore the productivity, connectivity, abundance and distribution of Grizzly bears and their habitats.

A Provincial Grizzly Bear Management Plan has been developed and is in review as of January 2021 in response to a report tabled by the B.C Auditor General in 2017 (OAG 2017, Garth Mowat, B.C Carnivore specialist, pers. comm.). The primary conservation concerns for grizzly

bears in B.C. include human-bear conflicts, anthropogenic habitat alteration, and loss of connectivity.

Human-bear conflicts are responded to by the B.C. Conservation Officer Service (COS), though this is a small part of a B.C Conservation Officer's duties. The B.C. COS is responsible for enforcing a wide variety of wildlife related laws and regulations including natural resource compliance and enforcement, hunting regulations, human safety, property damage and conflict response relative to all wildlife, including grizzly bears. The B.C. COS has detailed bear conflict response protocols that apply a decision tree based on the type of conflict, the history of the bear, threat level to people and property, and other factors (B.C. COS 2020a and 2020b). Responses to human-grizzly bear conflicts vary and can include education and information sharing, attractant management improvements and the promotion of electric fencing through ENGO programs, translocation of grizzly bears within or (more rarely) outside their home range, or euthanasia. On average, 44 percent of grizzly bears involved in conflicts responded to by the B.C. COS are killed by Conservation Officers; that number rises to 61 percent when private citizen kills are included (B.C. government data).

To help prevent human-grizzly bear conflicts, British Columbia has a province-wide government-sanctioned WildSafe B.C. program. This program is collaboratively delivered and includes education and community-based solutions. The program evolved from the provincial Bear Aware program, is administered by the B.C. Conservation Foundation, and works cooperatively with the Ministry of Environment's Bear Smart Program and the B.C. COS. Community based 'specialists' live and work within sponsoring communities to help develop place-based conflict mitigation options; the cost of these positions is shared between WildSafe and the sponsoring communities.

Motorized access management is known to be an important habitat management tool for grizzly bear conservation (Mace *et al.* 1996, Schwartz *et al.* 2010, Boulanger and Stenhouse 2014, Lamb *et al.* 2018. Proctor *et al.* 2020, 2021b). However, its use in B.C has been limited and no province-wide or GBPU-specific targets exist (Proctor *et al.* 2019, Morgan *et al.* 2020, Figure 2b). Exceptions to this pattern are in the southeast corner of B.C. in the Flathead and South Rockies GBPUs just north of the U.S. Glacier National Park, in southwest B.C. with a local initiative, in the Granby-Kettle GBPU to the west of the South Selkirks (Lamb *et al.* 2018) and in the privately owned Nature Conservancy of Canada Darkwoods lands within the South Selkirk GBPU (Proctor *et al.* 2018, 2021b).

Finally, the loss of connectivity is an additional conservation challenge for southern B.C.'s bear populations. B.C. Highway 3 runs east-west and bisects several GBPUs in southern B.C just north of the Canada-U.S. border (Figure 3). The north-south mountain ranges create a series of valleys that act as transportation and settlement corridors in the region. The combination of the fragmentation of B.C. Highway 3 and the north-south settled valleys have left a series of isolated or partially isolated sub-populations across the region, several of which are international sub-populations that span the Canada-U.S. border (Figure 3). Varying amounts of conservation management are being applied to reverse some of this fragmentation as discussed in the GBPU summaries that follow.

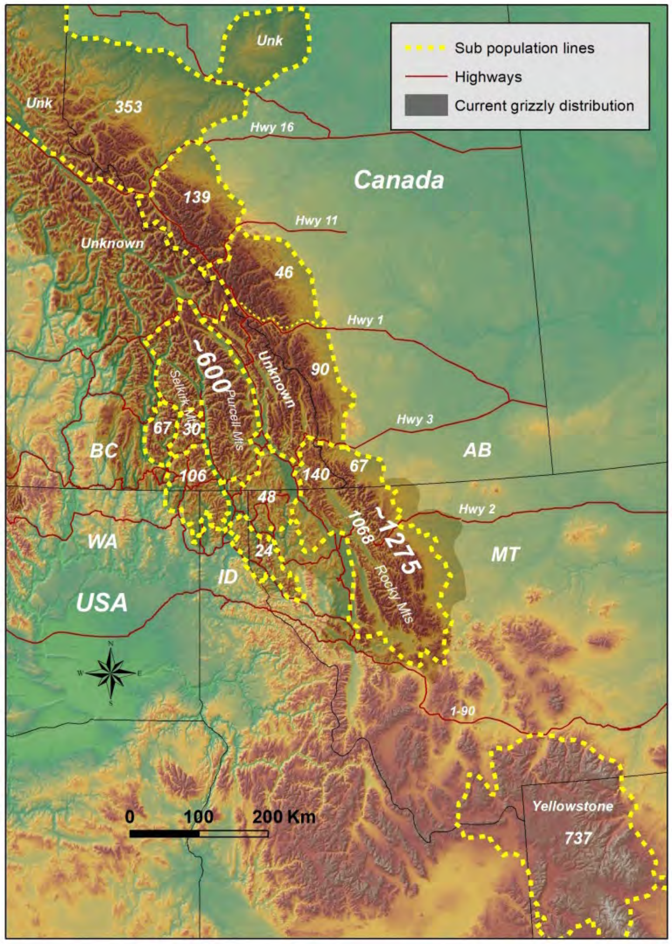

Figure 3: Fragmentation of grizzly bears, in the trans-border region spanning the Canada-U.S. border. Yellow dotted lines represent primarily female fragmentation, but with reduced male connectivity as well. Numbers are population estimates within these 'biological' subpopulations (adapted from Proctor et al. 2012).

British Columbia – U.S. border Grizzly Bear Population Units

There are 6 B.C. Grizzly Bear Population Units (GBPU) along the U.S. border that are immediately relevant to grizzly bear recovery ones in the lower-48 States (Figure 4). Here we review their status, research, conservation efforts, and relevance to grizzly bears in the lower-48 States.

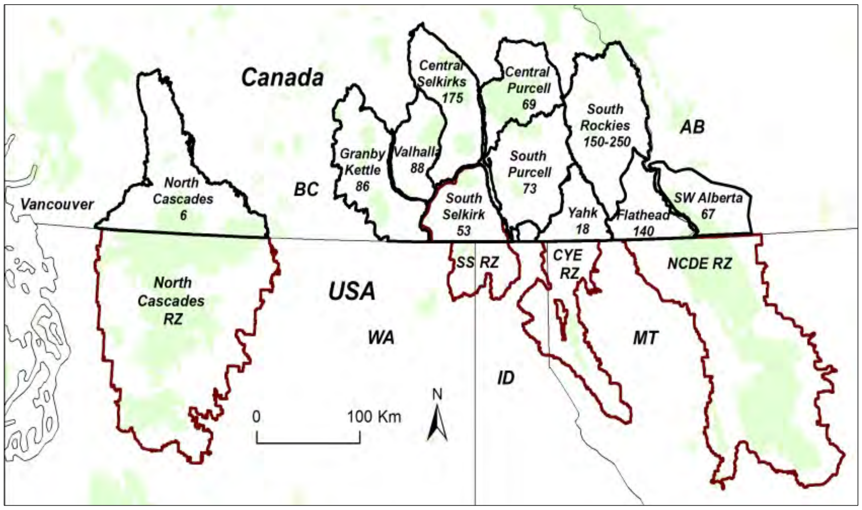

Figure 4: Grizzly Bear Population Units along the Canada-U.S. border in southern British Columbia, their estimated population size, and adjacent U.S. Recovery zones (B.C. Government 2020, Proctor et al. 2021b).

North Cascades

The North Cascade GBPU within Canada, up against the heavily human-populated lower mainland of B.C.'s southwest, is directly north of the U.S. North Cascades Recovery Zone and is estimated to have 6 bears within its ~9,800 km^2 area; however, this estimate is not backed up by reliable research (Figure 5, B.C. FLNRORD 2020). Between 1998 and 2003 several efforts were made to survey this population (DNA sampling, live trapping effort, aerial survey for a helicopter darting attempt,) with very little results beyond one DNA sample and few sightings that included a female with offspring (North Cascades Grizzly Bear Recovery Team 2004, McLellan *et al.* 2017b). This unit is designated as M1, the highest level of conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020). Approximately 20 percent of the GBPU is protected, (North Cascades Grizzly Bear Recovery Team 2004) and road densities vary across the GPBU and outside of the large, protected areas on the southern border; they range from 0.76 to 2.5 km/km^2 (Figure 6).

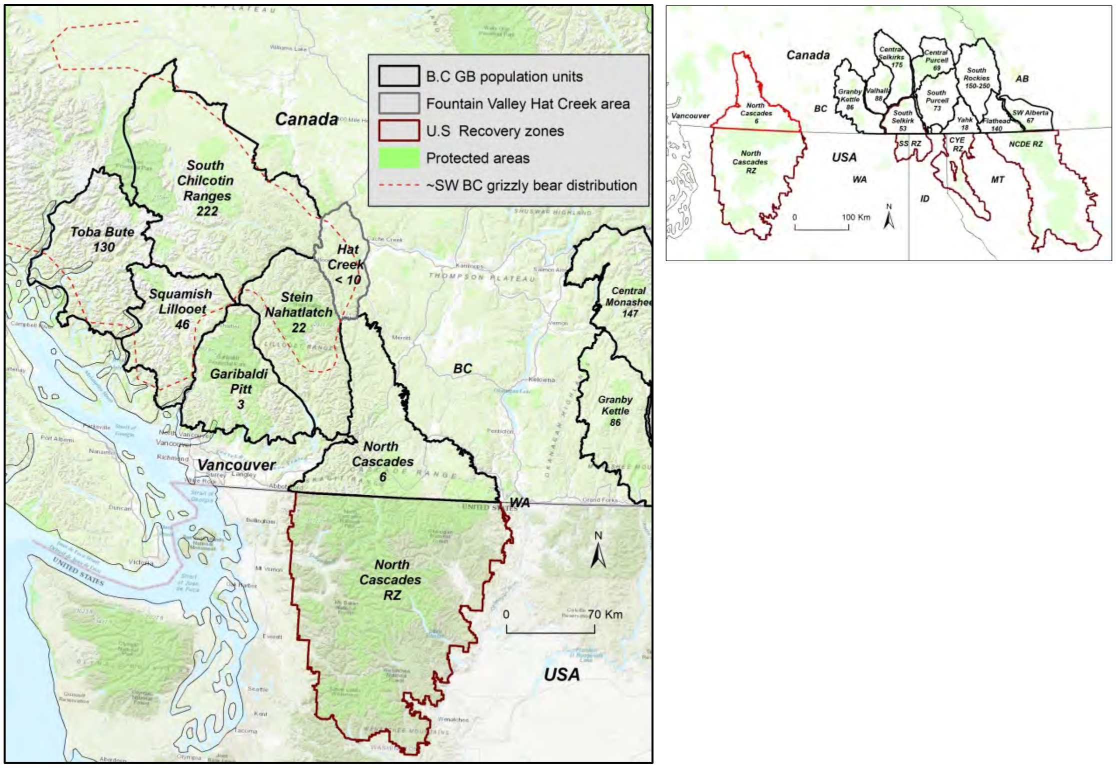

Figure 5: North Cascades region including the neighbouring Grizzly Bear Population Units to the northwest. The red dotted line is a data-based approximation of the grizzly bear distribution north of that line (Apps et al. 2014). The distribution in the North Cascades is unknown.

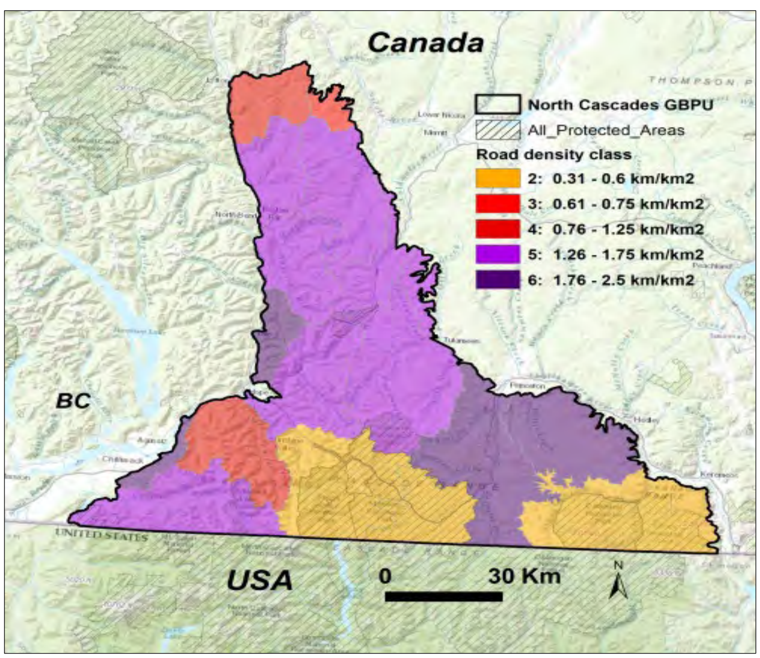

Figure 6: Road density classes in the North Cascade Grizzly Bear Population Unit of southwestern B.C.

The B.C. government developed a well-considered North Cascades Recovery Plan (North Cascades Grizzly Bear Recovery Team 2004) to recover and /or recolonize this population. Stated objectives included:

- conserve and enhance linkages (with the Stein Nahatlatch GBPU),
- augment the population genetically through the introductions of animals from other populations,
- manage habitat through motorized access controls if necessary,
- minimize human-bear conflicts,
- initiate recreation trail planning,
- minimize human-caused mortality of grizzly bears,
- cooperate with the U.S. authorities on recovery efforts, and
- monitor recovery progress.

The plan was never implemented due to the public's concern for translocating bears into the area (OAG 2017). No outreach effort was undertaken to alleviate those concerns (OAG 2017). Recently, however, the Okanagan Nation Alliance has undertaken efforts to update this Recover y Plan in collaboration with other First Nations, ENGOS and the B.C. government.

The North Cascade 'population' is totally isolated from adjacent populations (North Cascades Grizzly Bear Recovery Team 2004). Connectivity from the east is unlikely as the nearest population is over 100 km across the heavily human-settled Okanagan Valley (North Cascades Grizzly Bear Recovery Team 2004, McLellan *et al.* 2017b). To assess connectivity from the northwest it is useful to consider the GBPUs in that area (Figure 5). The immediately adjacent GBPU is the recovering Stein-Nahatlatch, itself ranked M1, and estimated to have a very low density of bears (2.9 bears/1,000km^2, or 22 grizzlies, B.C. FLNRORD 2020, Morgan *et al.* 2020, Apps *et al.* 2008, 2014) and very low genetic diversity estimated through genetic heterozygosity (H_E = 0.51, Apps *et al.* 2014). Both the North Cascades and Stein-Nahatlatch GBPUs are designated as 'Critically Endangered' small, isolated populations by the IUCN Red List (McLellan *et al.* 2017b). While the adjacent Stein-Nahatlatch GPBU is within the dispersal distance of both male and female grizzly bears, only the northern half is occupied by grizzly bears (Figure 5, Apps *et al.* 2008, 2014). The fracture that separates the North Cascades and the Stein-Nahatlatch is significant and consists of the large Fraser River valley and canyon, the heavily travelled Trans-Canada Highway, two railways, human settlements and other developments.

The Stein-Nahatlatch GBPU has been completely isolated until recently when it has experienced a few male exchanges with the South Chilcotin Ranges GBPU to the northwest, but no female interchange has been documented (McLellan *et al.* 2017b). The fracture separating the Stein-Nahatlatch from the South Chilcotin Ranges is of minimal intensity with a low volume railroad and highway, sporadic rural settlement, and several lakes (McLellan *et al.* 2017b).

The South Chilcotin Ranges GBPU is the closest larger healthier population of grizzly bears (222 bears, FLNRORD 2020), known to also be increasing (McLellan *et al.* 2019), that would be a source of genetic and demographic connectivity to the Stein-Nahatlatch and ultimately the North Cascades. For natural connectivity to occur between the South Chilcotin Ranges through the Stein-Nahatlatch and into the North Cascade GBPU, a considerable amount of population and connectivity recovery needs to occur. Briefly, the South Chilcotin Ranges GPBU would need to continue its recovery trajectory (a reasonable assumption given current efforts and attention), and

the Stein-Nahatlatch would have to do the same. That, however, is a bigger challenge because there are so few bears with limited distribution in this unit currently (McLellan *et al.* 2019). Beyond these improvements, the considerable fracture separating the Stein-Nahatlatch and the North Cascades created by the large highway, two railroads, large Fraser River, and human settlements would have to be overcome through extensive conservation management.

Considering the low density, limited distribution, fragmentation of the Stein Nahatlatch bears with the adjacent South Chilcotin Ranges GBPU to the north, and the severity of the fracture separating the Stein-Nahatlatch from the North Cascades, genetic or demographic connectivity to the North Cascades is unlikely in the near future. However, there are efforts in research and conservation management ongoing in the region that provide long-term potential for connectivity and recovery of the Stein-Nahatlatch and eventually the North Cascade GBPUs.

A considerable amount of conservation-oriented research has been occurring in the region to the northwest of the North Cascade GBPU (Apps *et al.* 2014, McLellan and McLellan 2015, McLellan *et al.* 2019), including work revealing population-level fragmentation (Apps *et al.* 2014) and identification of corridors across the valley fragmenting the Stein-Nahatlatch from the South Chilcotin Ranges GBPU (Figure 5, McLellan 2018). A consortium of ENGOs, First Nations, and the B.C. government have been working on implementing conservation solutions similar to those shown to be working in the South Selkirk GBPU (see below, Proctor *et al.* 2018), including conflict reduction strategies, purchase of private connectivity properties by a land trust, and initial motorized access management applications. A population augmentation program for the Stein-Nahatlatch GBPU is being planned as a cooperative effort between the B.C. Government and the local St'at'imc, NlaKa'pamux, and Simpcw First Nations (https://www.conservationnw.org/our-work/habitat/coast-range-to-cascades/). The source of non-salmon-dependent bears would likely come from healthy populations in central B.C. Plans are to continue this effort for 5 years and assess progress and success.

In addition to these GBPUs is the small Hat Creek area (~1,400 km^2) to the east of the Stein Nahatlatch GBPU (Figure 5) that possibly contains reproductive females (McLellan *et al.* 2017b). Also adjacent to the Stein-Nahatlatch GBPU is the Garibaldi Pitt GBPU which is possibly close to being functionally extirpated with an estimated 3 bears (FLNRORD 2020).

In summary, attaining natural or human-assisted genetic or demographic connectivity into the North Cascade GBPU will be a challenge that currently is not being considered as a management priority by the B.C. government (OAG 2017), but is within the long-term objectives of local First Nations and the aforementioned Coast to Cascades Grizzly Bear Initiative. Therefore, this unit is not considered a realistic source of bears to recolonize the U.S. North Cascades in the near future. However, First Nations reinvigoration of recovery plans for both the North Cascades and the Stein-Nahatlatch GBPUs in cooperation with the Coast to Cascades Grizzly Bear Initiative and the B.C government provides some hope for conservation progress in the region and should be of interest to authorities within the U.S. with interest in recovery of the North Cascades international population.

Granby-Kettle GBPU

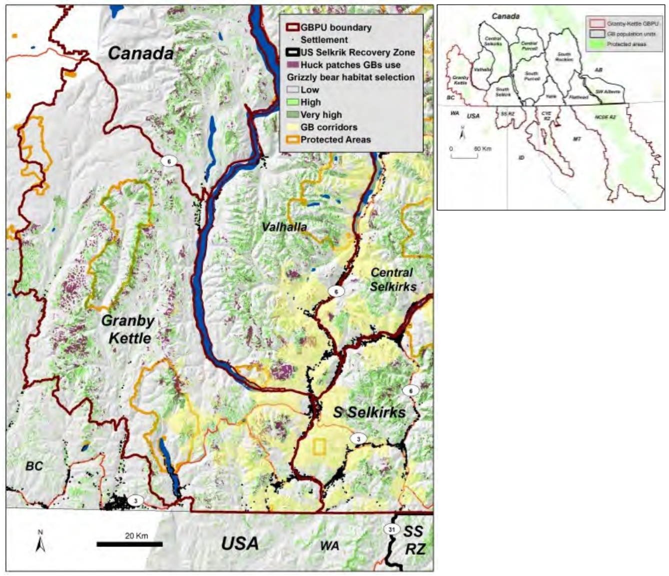

Figure 7: Granby-Kettle Grizzly Bear Population Unit along the Canada-U.S. border immediately northwest of the U.S. South Selkirk Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors, (yellow), and huckleberry patches (purple) are shown (Proctor et al. 2015, 2021b).

The next GBPU in the trans-border area is the Granby-Kettle unit (Figure 7), east of the Okanagan Valley from which grizzly bears are extirpated. This unit is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. Grizzly bears in the unit have not been legally hunted since 1995. The biggest threats to bears in this unit are the extensive and expanding forestry road network and its associated high ungulate hunter density and unreported mortalities (Morgan *et al.* 2020), although some recent progress has been made in motorized access management. There is limited human settlement or agriculture in the southern portion of this GBPU (black dots in Figure 7).

A recent DNA-based population survey estimated 87 grizzly bears (95% CI = 66–108) (Lamb *et al.* 2018) and represents an increase for this unit over an estimated 38 bears from a similar DNA survey in 1997 (Lamb *et al.* 2018). Between 1985 and 2001, 3 provincial parks were created in this unit encompassing 14 percent of the GBPU. In addition, two motorized access management areas (5 percent of unit area) were created to benefit grizzly bear recovery and other conservation goals. Lamb *et al.* (2018) estimated that the parks and motorized access management area helped increase the bear density by 27 percent and that habitats with road densities less than 0.6 km/km^2 had 3 times higher grizzly bears densities than habitats with road density greater than 0.6 km/km^2. Even with these efforts, the open road density in this unit is 1.64 km/km^2, short of a stated goal of 0.6 km/km^2 (B.C. Government Action Regulation 2004). The closest example of a GBPU-wide access management plan in B.C. occurred in this unit in 2010 when a government order was drafted to include a road density target, but it was only a recommendation in the final order. It was later determined by the B.C. Forest Practices Board that these targets were not being met in a significant number of areas primarily because they were not legally binding. This story is detailed in the Office of the B.C. Auditor General Report (OAG 2017).

The Granby-Kettle GBPU is bisected by B.C. Highway 3 and the degree of fragmentation it causes has not been researched. Regionally, fragmentation is mediated mainly by settlement and mortality patterns and secondarily by traffic along Highway 3 (Proctor *et al.* 2012, Lamb *et al.* 2016). There are extensive sections along B.C. Highway 3 across this unit with no-to-minimal human settlement, so extrapolating the results of Proctor *et al.* (2012), it is likely that grizzly bear connectivity occurs across this highway to some degree as is the case with the unsettled Highway 3 that bisects the South Selkirk GBPU (see below).

While no direct habitat quality or telemetry-based research has occurred in the Granby-Kettle unit, Proctor *et al.* (2015) extrapolated their extensively evaluated resource selection function habitat model and grizzly bear corridor predictions into much of this unit (Figure 7). Further, Proctor *et al.* (2021) applied their huckleberry patch 'important-for-grizzly-bears' model into this unit after satisfactory local field evaluation (Figure 7). Combined with the density surface and road density analyses (Lamb *et al.* 2018) and the Proctor *et al.* (2015, 2021b) efforts, enough preliminary data exists for this unit to implement targeted conservation management such as the one attempted by the provincial government in 2010 (described above) and expand access management to other areas within this GBPU as they have done in portions of the unit (Proctor *et al.* 2020, 2021b).

In summary, the Granby-Kettle GBPU shares a 35 km border with the western edge of the Canadian South Selkirk GBPU (Figure 7). The areas near this border within each GBPU contain a lower density of grizzly bears relative to other portions of the GBPUs and B.C. Highways 22 and 3B and their associated human settlement likely provide a degree of fragmentation between these two GBPUs. As such, the Granby-Kettle GBPU represents only minimal potential for grizzly bear connectivity with the South Selkirks. Likely a better potential exists for bears within the Granby-Kettle to be a source for bears into adjacent areas in northern Washington, although no known population exists there now.

South Selkirk GBPU

The Canadian South Selkirk GBPU is directly north of the U.S. South Selkirk and is part of the U.S. Recovery zone (Service 1993), although it is managed entirely by Canada (Figure 8a). Protected areas in this GBPU include the West Arm Provincial Park (253 km^2) along the northern border of the unit and the adjacent roadless Midge Creek Wildlife Management Area (created in 1998, 148 km^2). These protected areas adjoin the 700 km^2 Nature Conservancy Canada (NCC) property, currently being managed for grizzly bear and other conservation values (Figure 8b). This unit is designated as M2, high conservation concern, according to the B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. Grizzly bears in the unit have not been legally hunted since 1995. The South Selkirk subpopulation was found to be completely isolated (at the time) from adjacent subpopulations to the north, east, and west (Proctor *et al.* 2005, 2012) and the IUCN Red List assessment designated this population as 'Vulnerable' (McLellan *et al.* 2017b). Its small population size, complete isolation (at the time), and threats assessment suggested it should be 'Endangered'. It was designated the lesser status of 'Vulnerable' because of ongoing research and effective conservation management applied by the Trans-Border Grizzly Bear Project, the Service, and the B.C. Conservation Officer Service (Proctor *et al.* 2018, Kasworm *et al.* 2020*a*).

These cumulative efforts greatly reduced its probability of extinction. More recently, Proctor *et al.* (2018) have documented increased genetic and demographic connectivity between the South Selkirk and Purcell GBPUs (see details below).

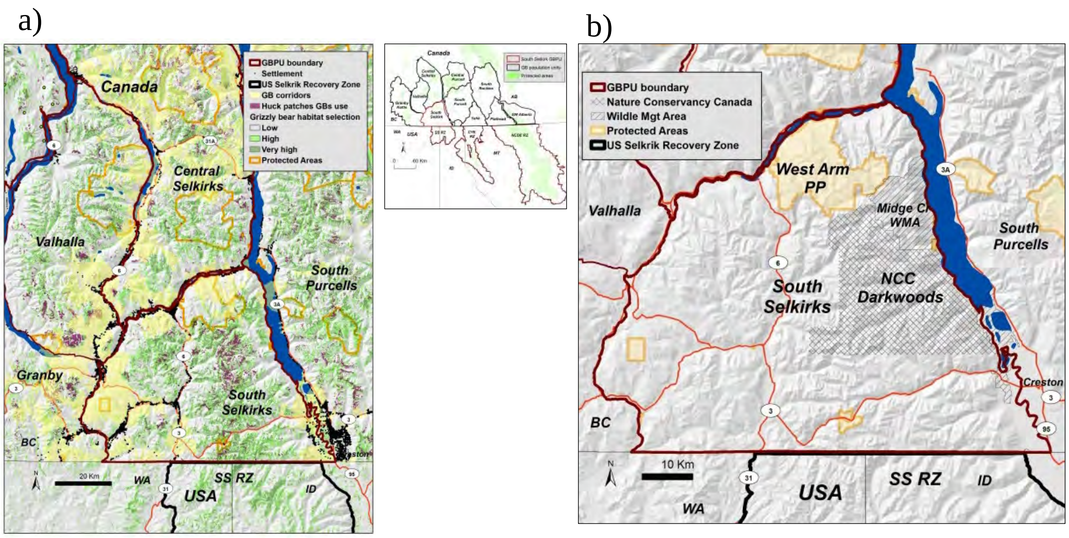

Figure 8: a) South Selkirk Grizzly Bear Population Unit along the Canada-U.S. border immediately north of the U.S. South Selkirk Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors, (yellow), and huckleberry patches (purple) are show, (Proctor et al. *2015, 2021b), and b) protected lands in the South Selkirk Grizzly Bear Population Unit.*

Threats to this population were (and still are to some degree), human-caused mortality primarily on the periphery, extensive forestry roads on public lands and the accompanying mortality (within Canada), and fragmentation. The Trans-border Grizzly Bear Project wrote a government sanctioned (‘advice to government’) Recovery Management Plan (MacHutchon and Proctor 2016). The recovery targets in this plan were patterned after targets used by the Service’s recovery of the U.S. South Selkirk Recovery Zone with several changes to reflect the Canadian program. Most of the targets were designed to be measured in a unit-wide DNA-based population survey and include, abundance, density with explanatory covariates, female distribution, distribution of reproductive females, sustainable mortality rates, sex-specific connectivity with neighboring populations and more. A DNA-based population survey is being carried out in 2020–2021, to assess conservation status using the above metrics.

There has been a significant amount of conservation–oriented grizzly bear research in the South Selkirks by the Trans-border Grizzly Bear Project, in partnership with the Service’s Libby Office. A DNA-based population survey was done in 2005, which estimated the Canadian South Selkirk unit to have 58 bears (95% CI = 50–70) (Proctor *et al.* 2007). A re-analysis of the same data using the more recent Spatial Explicit Capture Recapture (SECR) methodology estimated 53 bears (95% CI = 41–68) (Proctor *et al.* 2021b). Forty grizzly bears were collared with GPS telemetry between 2007–2017, the data of which were used to estimate habitat quality, important hyperphagia food patches, connectivity corridors, female reproduction, sources and rates of mortality, conflict management, and more (Figure 8a). Proctor *et al.* (2021b) identified and mapped huckleberry patches important for grizzly bears using GPS telemetry to find the patches and model their distribution (Figure 8a). Interestingly, they found that huckleberry patches in areas of high road density and low proportion secure habitat were not translating into grizzly

bear densities. For example, the average open road density in the unit is 1.1 km/km^2 while the open road density in the Nature Conservancy Canada's land is 0.3 km/km^2 attained through an access management program on their lands. The average bear density for the entire unit is 13.1 grizzly bears/1,000 km^2, while the grizzly density in the NCC Darkwoods property is 33 grizzly bears/1,000 km^2. This higher bear density in the NCC Darkwoods lands is a result of the combination of a low road density and a higher huckleberry patch density (Figure 9a and b. Proctor *et al*. 2018, 2021). Proctor *et al.* (2021b) found that grizzly bear densities were 2.5 times higher in habitats less than 0.6 km/km^2 open road density, relative to habitats greater than 0.6 km/km^2.

a)

b)

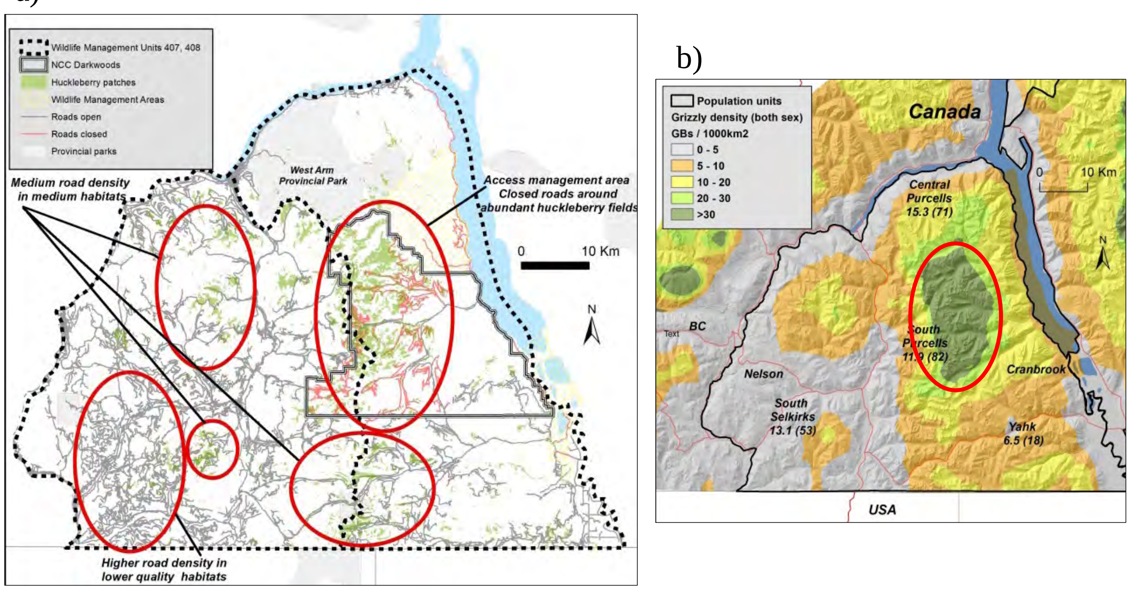

Figure 9: a) An example of resource road management on Nature Conservancy of Canada lands in the South Selkirk Mountains as a mitigation for backcountry mortality and to increase habitat effectiveness (adapted from Proctor et al. 2018). Public access was controlled around good huckleberry patches, and this resulted in increased female habitat use, density, and realized reproductive output (fitness). Adapted from Proctor et al. (2018), and b) Grizzly bear density in the South Selkirk Grizzly Bear Population Unit. Red oval indicated are of highest density that corresponds to the upper right red oval in a) where access management has been applied by the Nature Conservancy Canada and huckleberry patch density is high (Proctor et al. 2021b).

Road density and the proportion of secure habitat (greater than 500 m from an open road) varies across the South Selkirk GBPU. The Trans-border Grizzly Bear Project subdivided this unit (and other GBPUs in the Purcell Mountains) into 'Bear Management Units' (BMUs) for the purpose of understanding the spatial variability of these access metrics (Figure 10a and b). Note these BMUs are not legal entities, but are used for conservation planning. This exercise exposes local areas within these units that would benefit from access management as recommended in Proctor *et al.* (2020).

a) b)

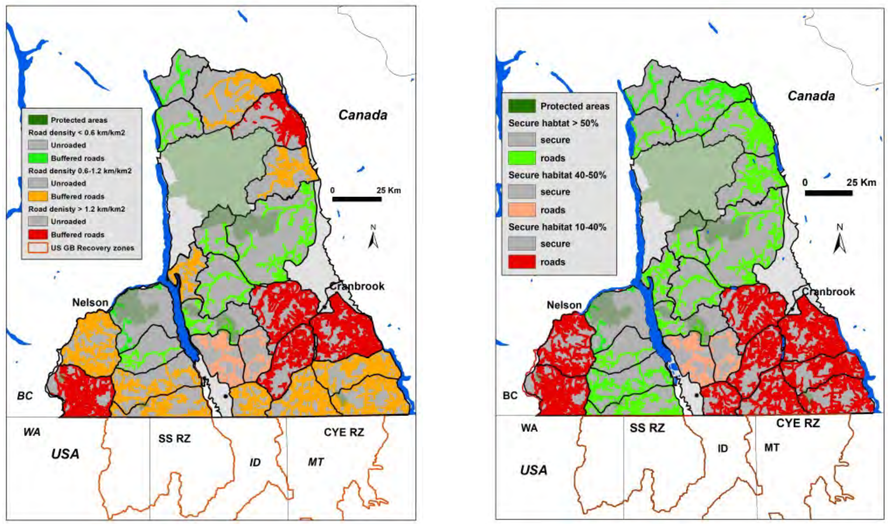

Figure 10: a) Road density categories within 'Bear Management Units' (created by the Trans-border Grizzly Bear Project to help understand road access, these are not legal entities) across the South Selkirk, Yahk, South Purcell and Central Purcell Grizzly Bear Population Units in southeastern B.C. Adapted from MacHutchon and Proctor 2016). Colors are open roads buffered by 500 m, and b) Percentage of secure habitat (> 500m form an open road) across the same Bear Management Units.

a) b)

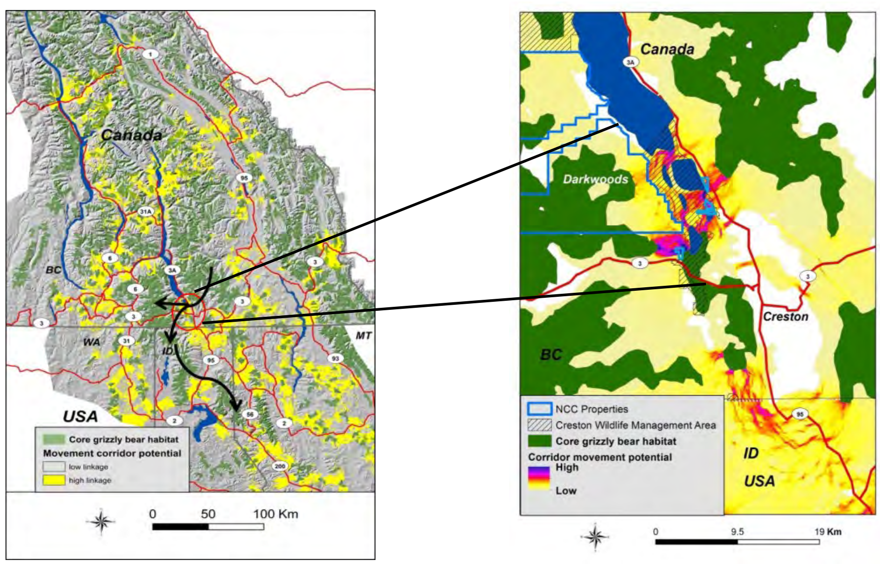

Figure 11: a) Research-identified grizzly bear corridors in the trans-border Canada-U.S. region (Yellow) connecting higher quality habitat patches (green). The black arrows represent the best corridor option connecting the U.S. South Selkirk grizzly bears to the larger Canadian population in the Purcell Mountains through the Creston Valley (red circle) and b) Close up of the Creston Valley showing the best linkage habitat (red flames) in relation to connectivity land purchases by the Nature Conservancy Canada (NCC, blue polygons, adapted from Proctor et al. 2018).

The fragmentation that originally created this previously isolated population was primarily from B.C. Highway 3A that runs north of Creston and west to Nelson along Kootenay Lake. B.C. Highway 3 cuts east-west through the South Selkirk unit but does not significantly fragment grizzly bears as there is virtually no human settlement along the highway as it crosses much of the unit (Proctor *et al.* 2012).

Proctor *et al.* (2015) identified the best options for establishing a grizzly bear corridor to a larger population to be across the north end of the Creston Valley into the south Purcell Mountains (Figures 11a and b). The Trans-border Grizzly Bear Project has implemented a suite of connectivity conservation and management actions over the past decade (Proctor *et al.* 2018). Activities included a cost-share electric fencing program, other attractant management activities, a private land purchase program (i.e., purchasing lands or conservation easements within identified corridors through the NCC and other land trust ENGOs, Figure 11b), and a non-lethal conflict response program in conjunction with the B.C. COS - patterned after the Montana Fish Wildlife & Parks bear management program. These activities have resulted in a decrease in human-caused mortality in the South Selkirk GBPU relative to the previous decade (Figures 12a, b, Proctor *et al.* 2018). Conversely, mortality trends in the adjacent population unit to the east that did not receive these management activities have continued to increase (Figure 12c).

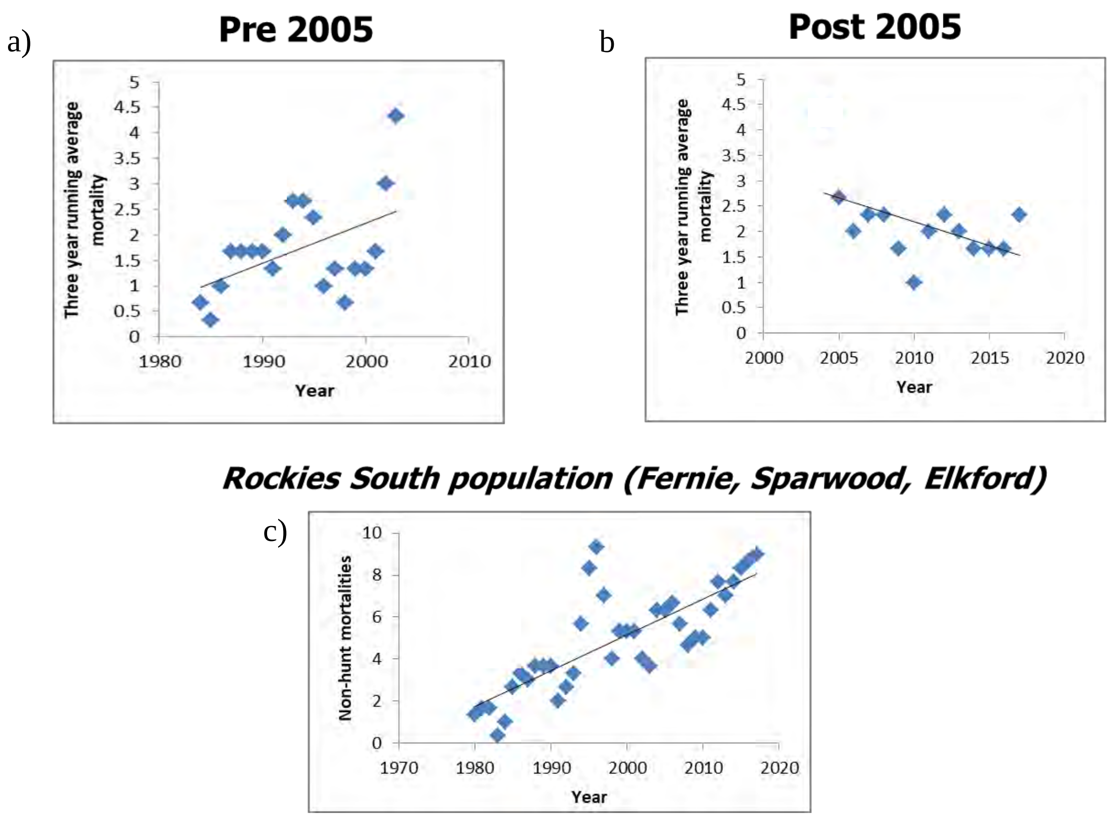

Figure 12: a) Conflict-related human-caused grizzly bear mortality in the Canadian South Selkirk Grizzly Bear Population Unit prior to the instigation of connectivity mortality reduction management actions, b) mortalities after the initiation of mortality reduction management, and c) human-caused mortality in the adjacent valley to the east where connectivity mortality reduction management was not applied with the same intensity as in the Creston Valley area (adapted from Proctor et al. 2018).

The South Purcell population unit is the southern tip of a much larger healthier population of approximately 600 grizzly bears (Proctor *et al.* 2012). The Creston Valley grizzly bear corridor is the best option for reconnecting the U.S. South Selkirk population to a large healthy population north of B.C. Highways 3 and 3A (Figures 7a and b). Recent research has found increasing levels of genetic and demographic connectivity to be occurring between grizzly bears in South Selkirk and South Purcell Mountains as a result of the above-mentioned conservation

management actions (Figures 13 and 14, Proctor *et al.* 2018). Proctor *et al.* (2018) documented an increase in heterozygosity, a measure of genetic diversity, from 0.54 to 0.57, and 13 of 15 microsatellite loci tested increased their number of alleles between 2005 and 2017. They also documented an increase in the number of female and male immigrants into the Selkirk population from the Purcell Mountains to the east (1 female prior to 2005 to 4 females by 2017, and 0 males before 2005 to 6 males by 2017 (Figures 14a and b). They also documented movement into the South Selkirk GBPU from the South Purcell GBPU accompanied by breeding (Figure 13, Proctor *et al.* 2018). More recently the research team identified a female immigrant into the Selkirk GBPU that bred (unpublished data).

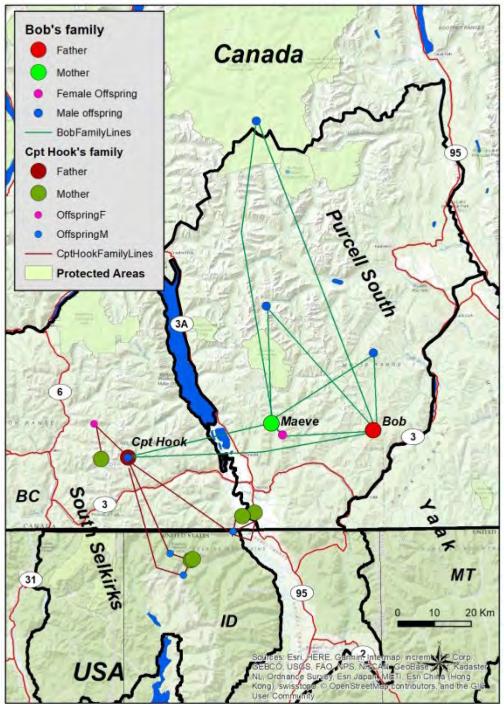

Figure 13: Example of grizzly bear (Ursus arctos) movement and gene flow across the Creston Valley from the South Purcell Mountains to the previously isolated South Selkirk population in the Canada-U.S. trans-border region. Example is a family pedigree where offspring all share 1 allele from each parent across 21 loci. Lines connect offspring to their parents. Dot locations represent each bear's capture or sample location. In this extended family, Bob and Maeve produced offspring Cpt. Hook who moved from the South Purcell into the South Selkirk Mountains where he mated with 5 separate females yielding six offspring (1 of the blue dots for male offspring represents 2 offspring sampled at the same location). Adapted from Proctor et al. 2018.

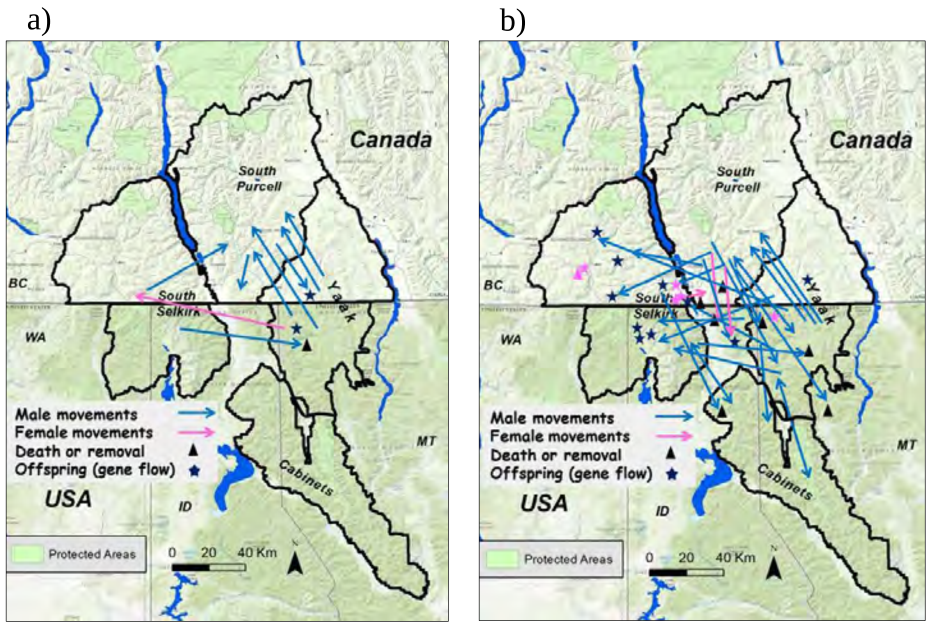

Figure 14: a) Cumulative evidence of inter-population grizzly bear (Ursus arctos) movements and gene flow (breeding events after movements) prior to 2006 and b) after mortality reduction management was applied post-2006 in the Canada-U.S. trans-border region of northwest Montana, northern Idaho, and southeast B.C (adapted from Proctor et al. 2018).

In summary, the Canadian South Selkirk GBPU is the most important link for the bears in the U.S. portion of the South Selkirk Recovery Zone to be connected to a larger grizzly bear population in Canada. This genetic and demographic connectivity has its best hope across the Creston Valley just north of the U.S. border north of Bonners Ferry, Idaho (Proctor *et al.* 2015). Recent and ongoing conservation efforts within Canada have measurably enhanced both genetic and demographic connectivity for the South Selkirk Recovery Zone (Proctor *et al.* 2018), however, the job is not complete. While progress in the right direction is apparent, sustained efforts are needed to make these improvements permanent and to install the management paradigms within Canadian society. This entails the B.C. Conservation Officer Service continuing its work to apply non-lethal management to appropriate conflict bears, the continuation of the privately run 50 percent cost-share electric fencing program, further and improved management of deadstock in the agricultural community of the Creston Valley, improved management (installed and maintained electric fences) of cherry orchards in the valley, and improved management of bear attractants on dairy farms. These solutions need to be made permanent fixtures in the way rural residents, farmers, and ranchers live and do business in the region. These have been the goals of the Trans-border Grizzly Bear Project and while they operate, there has been forward movement.

However, the Trans-border Grizzly Bear Project was not developed to be a permanent fixture on this landscape. Further, while the B.C. government has been an important partner in conservation management activities to this point in time, they are not currently prepared to be the leader of grizzly bear conservation and management into the future. Similarly, even government policies are not permanent and are subject to changing political climates. Facilitating coexistence between bears and people in multi-use landscapes is a persistent challenge, and one that requires engagement from multiple parties. Wildlife is a public good, and as such, responsibility for both facilitating and maintaining coexistence should not fall solely on one

group. As such, we look to both public and private players to continue these promising conservation efforts.

Yahk GBPU

The Canadian Yahk GBPU is directly north of the Yaak portion of the U.S. Cabinet-Yaak recovery zone. While the two areas are fully connected across the international border, the Canadian Yahk, is not a part of the U.S. Cabinet-Yaak recovery zone (Figures 4 and 10). Provincial parks in the unit amount to approximately 1 percent (28 km^2) of the unit (Figure 10). This unit is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. Grizzly bears in the unit have not been legally hunted since 1976. The international Yahk/Yaak subpopulation was found to be primarily female fragmented from adjacent subpopulations to the north, east, and west (Proctor *et al.* 2005, 2012). The IUCN Red List assessment designated this population as 'Endangered' (McLellan *et al.* 2017b) due to its small population size and female fragmentation. It was not down listed to 'Vulnerable" because at the time, its conservation metrics were not as promising as they are today (Kasworm *et al.* 2020b). In particular, the trend estimates and connectivity metrics have improved (become positive) in recent years (Kasworm *et al.* 2020b, Proctor *et al.* 2020). These improvements reduce its probability of extinction.

Threats to this population were (and still are to some degree), human-caused mortality primarily on the periphery, extensive forestry roads and the accompanying mortality (within Canada), and fragmentation. The Trans-border Grizzly Bear Project Recovery Management Plan discussed in the South Selkirk GBPU section also covers this population unit (MacHutchon and Proctor 2016). There is a possibility of a DNA-based population survey being carried out in the near future to assess conservation status using the metrics defined by the recovery management plan.

There has been a significant amount of conservation-oriented grizzly bear research in the Yahk by the Trans-border Grizzly Bear Project, in partnership with the Service's Libby Office. A DNA-based population survey was done in 2004–2005, which estimated the Canadian Yahk unit to have 20 bears (95% CI =16–24) (Proctor *et al.* 2007). A re-analysis of the same data using the more recent Spatial Explicit Capture Recapture (SECR) methodology estimated 18 bears (95% CI = 13–25 Proctor *et al.* 2021b). Grizzly bears were fitted with GPS telemetry between 2004–2010, the data of which were used to estimate habitat quality, important hyperphagia food patches, connectivity corridors, female reproduction, sources and rates of mortality, conflict management, and more (Figure 15). Proctor *et al.* (2021b) identified and mapped huckleberry patches-important-for-grizzly bears using their GPS telemetry to find the patches and model their distribution (Figure 15). The average open road density in the unit is 1.6 km/km^2. The average bear density for the entire unit is 6.5 grizzly bears/1,000 km^2 and is low relative to other units in the region (Figure 10, Proctor *et al.* 2012, B.C. Min FLNRORD 2020). The low bear density in the Canadian Yahk is likely related to the overall low huckleberry patch density and higher road density (Figures 10 and 15, Proctor *et al.* 2021). Proctor *et al.* (2021b) estimated that there is potential for increased numbers of grizzly bears in the Yahk unit through the application of access management. Decreasing road density to the recommended target of 0.6 km/km^2 has the potential to double the numbers of bears in the Canadian Yahk (Proctor *et al.* 2021b).

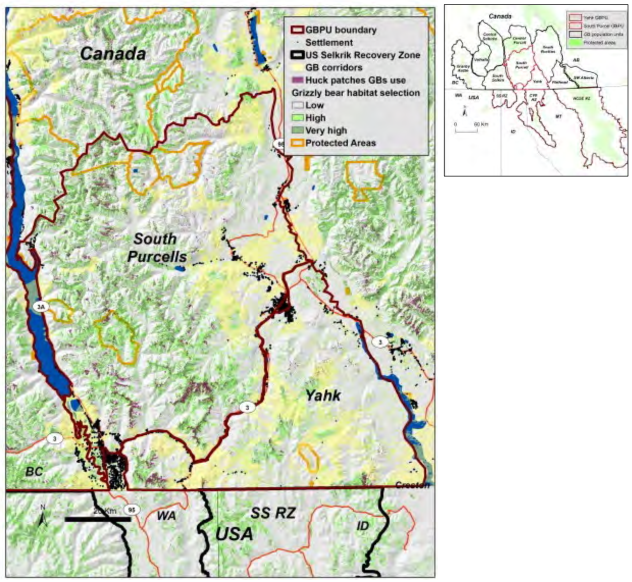

Figure 15: Yahk and South Purcell Grizzly Bear Population Units along the Canada-U.S. border immediately north of the US South Selkirk Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors, (yellow), and huckleberry patches (purple) are shown (Proctor et al. *2015, 2021b).*

The fracture creating this female fragmented population is primarily from B.C. Highway 3 that runs east-west across the Purcell Mountains. This highway and associated settlement have been shown to limit female bears and reduce male movements (Proctor *et al.* 2005, 2012). Proctor *et al.* (2015) identified the best options for establishing a grizzly bear corridor to a larger population to be across B.C. Highway 3 into the South Purcell Mountains (yellow in Figure 15). As mentioned above for the South Selkirk GPBU, the Trans-border Grizzly Bear Project has implemented a suite of connectivity conservation management actions over the past decade. These activities have resulted in an increase in connectivity between the Yahk and the South Purcell population unit to the north (Figure 14, Proctor *et al.* 2018). The South Purcell population unit is the southern tip of a much larger healthier population of approximately 600 grizzly bears (Proctor *et al.* 2012). The research-identified corridors are the best option for reconnecting the U.S. Yaak grizzly bear population to a large healthy population north of B.C. Highway 3 (Figures 3 and 15).

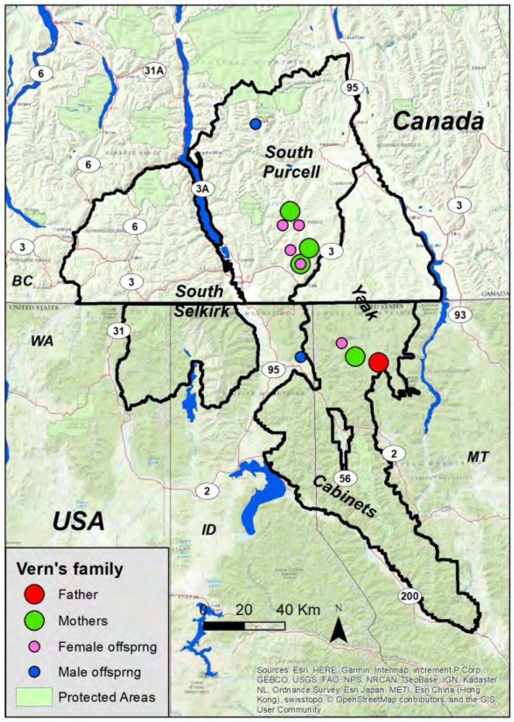

Figure 16: An example of male mediated gene flow across B.C. Highway 3 in the Purcell Mountains. Adult male Vern (red dot) mated with females (green dots) producing various offspring (smaller dots) north and south of B.C. Highway 3. Dot location are individual's capture or hair sample locations.

In summary, the Yahk GPBU is in need of access controls as the road densities in this unit (1.6 km/km^2) are well above the often-used target of 0.6 km/km^2 (Figure 10a and 18). If this target were adopted and met, there is the potential to double the number of bears in this GBPU (Proctor *et al.* 2021b). The other arena for improved conservation management is along the eastern edge, where human-caused mortalities have accumulated and significantly contribute to lower abundance and fragmentation of this population (Figure 17, Proctor *et al.* 2018). Conflict reduction measures have been slowly increasing in recent years in this area, so reductions in human-caused mortality are expected. To be fair, implementing access management across the Yahk GBPU will be a challenge due to strong public opposition and heavy industrial timber harvest.

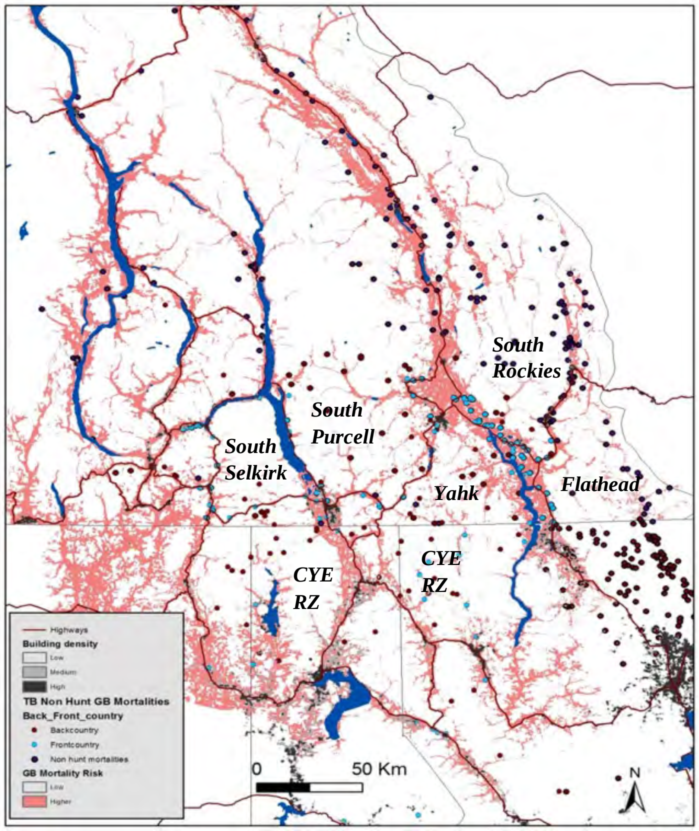

Figure 17: Cumulative non-hunt human-caused grizzly bear mortality in the Canada-U.S. trans-border area between 1984–2017. Blue dots are front country mortalities and dark red dots are backcountry mortalities. Red is modeled mortality risk.

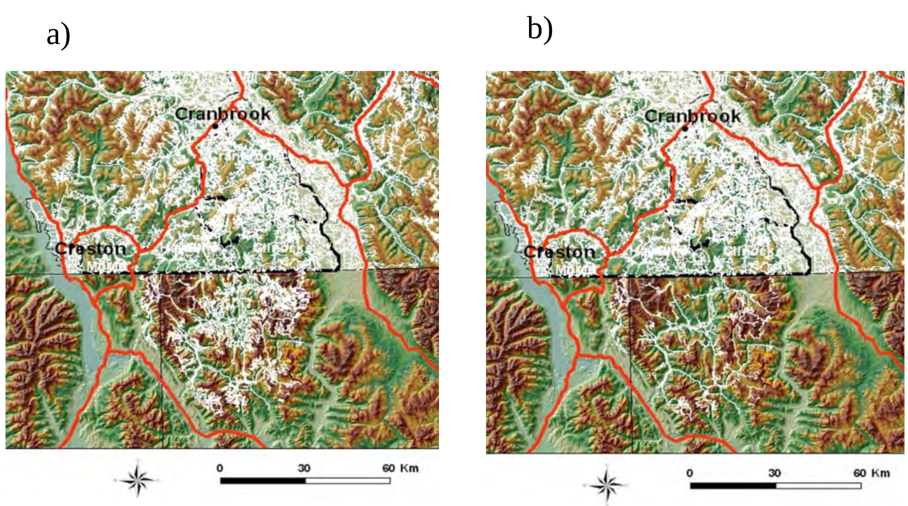

Figure 18: The pattern of access management applied in the international Yahk/Yaak ecosystem a) shows the total roads in both the U.S. and Canadian portions, and b) the U.S. portion show the open roads after access management has been applied.

South Purcell GBPU

The south Purcell GBPU is directly north of the Yahk unit and still close to the U.S. border (8 km at its closest) and thus plays a role in U.S. grizzly bear recovery (Figure 15). This unit is designated as M2, high conservation concern, according to the B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it needs conservation attention. However, it is the southern edge of a larger healthier population of fully connected GBPUs partitioned for management convenience that extends northward approximately 250 km (~150 miles) and contains an estimated 600 grizzly bears (Figure 3, Proctor *et al.* 2012). The M2 designation reflects threats to this population including, human-caused mortality primarily on the periphery, and extensive forestry roads and the accompanying mortality. As such, this population unit represents the larger population that offers genetic and demographic connectivity to both the South Selkirk and Yahk GBPUs and their associated populations in the U.S. lower-48 States. Efforts to re-establish connectivity across B.C Highways 3 and 3A would benefit the long-term health of the U.S. South Selkirk and Yaak grizzly bears populations (Figures 3, 4, and 14) and are ongoing (Proctor *et al.* 2018).

There has been substantial conservation-oriented grizzly bear research in the South Purcell unit by the Trans-border Grizzly Bear Project, in partnership with the Service's Libby Office. A series of smaller DNA-based population surveys designed to assess fragmentation patterns (but useful for population estimation) were done between 1998 and 2005, and GPS telemetry occurred between 2004–2017. These data were used to estimate abundance, density, habitat quality, important hyperphagia food patches, connectivity corridors, female reproduction, sources and rates of mortality, conflict management, and more (Figure 15). Proctor *et al.* (2021b) identified and mapped huckleberry patches-important-for-grizzly bears as reported above for other GBPUs (Figure 15). The average open road density in the unit is 1.0 km/km^2. The average bear density for the entire unit is 11.9 grizzly bears/1,000 km^2 with 73 bears (95% CI = 56–96) estimated from data collected between 2001–2005 (Proctor *et al.* 2021b). This estimate is also 15 years old (in 2021) and the current density of the South Purcell unit is unknown. Grizzly bears in the unit were legally hunted up until the B.C.-wide grizzly bear hunt closure in 2017. Occasionally, the combination of non-hunt conflict mortality and the legal hunt exceeded total mortality limits for this population (Artelle *et al.* 2013). However, the hunt was closed periodically to mitigate the excessive mortalities and allow the bear numbers to recover as per provincial protocol (Hamilton and Austin 2004).

In summary, the South Purcell GBPU could benefit from an organized access management plan to lower road densities particularly around the best huckleberry patches identified in Proctor *et al.* (2021b). Continued and increased efforts to minimise human bear conflicts on the periphery of this unit would also be beneficial for population recovery as well as improving its ability to act as a source population for migrants into the Yahk and the South Selkirks. These two actions would work to increase the potential of connectivity with the Yahk and South Selkirk populations – and ultimately with the U.S. recovery zones of these ecosystems.

Flathead GBPU

The Canadian Flathead GBPU is directly north of the U.S. North Continental Divide Ecosystem (NCDE) recovery zone including portions of the U.S. Glacier National Park (Figures 4 and 19). While the two areas are fully connected across the international border, the Canadian Flathead is not a part of the U.S. NCDE recovery zone (Figure 4). This GBPU is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. This concern comes from threats and fragmentation related to conflict mortality on the unit's periphery along B.C. Highways 3 and 97, forestry roads, and high ungulate hunter density and the accompanying mortality (Proctor *et al.* 2012, Lamb *et al.* 2016, McLellan *et al.* 2018, Morgan *et al.* 2020). Human-caused mortality related to human-bear conflicts on the periphery of this unit remain a significant issue in this unit (Figure 17, Mowat and Lamb 2016, Lamb *et al.* 2016, Proctor *et al.* 2018). With the goal of future mitigation of these human-caused mortalities, there is an ongoing research project to identify sources of unreported mortality in the area that separates the South

Rocky, Flathead and Yahk GPBUs and to inform management actions (C. Lamb, pers. comm.). Recently, attractant management is beginning to be pursued in earnest.

B.C. Highway 3 transverses the Rocky Mountains east to west and creates the northern boundary of this GBPU as it does in the Purcell Mountains to the west. The big difference is that the number of bears to the south of B.C. Highway 3 in this relatively large biological population includes bears in B.C (~140), Alberta (~67), and Montana (~1,068) totalling more than 1,200 bears (Figure 3, Kendall *et al.* 2009, Proctor *et al.* 2012, Mace *et al.* 2012, Morehouse and Boyce 2016, B.C Min. of FLNRORD 2020, Costello and Roberts 2020, Service 2020). While the best (easiest to repair) and most important link to bears in the rest of Canada occurs across B.C. Highway 3, the relatively large size of this international population leaves it fairly secure. While there is evidence of reduced demographic and genetic gene flow across B.C. Highway 3, males have been mediating genetic connectivity (Proctor *et al.* 2005, 2012). However, development along B.C. Highway 3 is ever increasing and the window of opportunity to establish effective wildlife and grizzly bear corridors may be closing. Therefore, if grizzly bear connectivity is a priority in this area, connectivity management along this transportation and settlement corridor should be pursued.

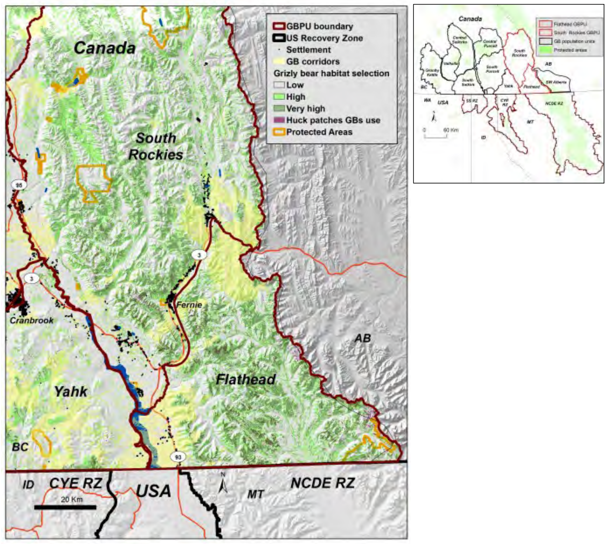

Figure 19: Flathead and South Rockies Grizzly Bear Population Units along the Canada-U.S. border immediately north of the U.S. NCDE Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors, (yellow), and huckleberry patches (purple) are shown (Proctor et al. 2015, 2021).

Canadian bear researcher Dr. Bruce McLellan has been researching bears in the North Fork of the Flathead just north of the U.S. border since the late 1970s. This is one of the most extensively studied bear populations in North America (McLellan and Shackleton 1988, McLellan 1989a, b, c, McLellan and Hovey 1995, 2001a, b, McLellan 2011, 2015, McLellan *et al.* 2018). McLellan's study area was the southeastern portion of the Flathead GBPU, less than 15 percent of the unit's area. McLellan found a relatively high bear density that undulated with huckleberry productivity roughly corresponding to each of 3 decades between 1979–1988, 1989–1998 and 1999–2010 (McLellan 2015). He concluded that because this population was far from human settlements, and extensive post-forest-fire-induced huckleberry patches were separated from forestry roads in mid-to high elevation open slopes, grizzly bear densities were high relative to other interior non-salmon grizzly bear populations (McLellan 2011, 2015, Mowat *et al.* 2013). He found that densities of bears ***excluding*** independent males ranged from 16–55 bears/1,000 km^2 in spite of this area receiving the highest per bear capita legal hunt rate (McLellan 2015).

The current density of the entire GBPU is estimated to be 41 bears/1,000 km^2 (140 bears, B.C. Min of FLNRORD 2020), with an estimated average road density of 0.96 km/km^2. We note, however, that variability in this road density estimate exists due to access management (B.C. Min. FLNRORD 2017). Of note and in contrast, the density of grizzly bears in the adjacent Yahk GBPU is estimated to be 6.5 grizzly bears/1,000 km^2, due to a lower huckleberry patch density (30 percent of the Flathead huckleberry patch density) and higher open road density (1.6 km/km^2, Proctor *et al.* 2021b). DNA-based surveys have been done across the Flathead GPBU in 1997 and 2007 (Boulanger 2001, Proctor *et al.* 2010). A multi-method (DNA corral & rub trees) monitoring effort has been carried out since 2007 (Mowat *et al.* 2013, Mowat and Lamb 2016). They found that across the entire GPBU, the population declined between 2007 and 2010 and increased again between 2010 and 2014, similar to patterns McLellan (2015) reported for his smaller Flathead study area in the southeast portion of the unit. Grizzly bears in the unit have not been legally hunted since the province-wide hunt closure in 2017.

There has been a significant amount of conservation research and effort related to improving connectivity across B.C. Highway 3 separating the Flathead and South Rocky GBPUs (Apps *et al.* 1997, Apps *et al.* 2007, Chetkiewicz and Boyce 2009, Clevenger *et al.* 2010, Proctor *et al.* 2012, 2015, Lamb *et al.* 2016, Lee *et al.* 2019). As a result of this attention, a spectrum of groups and government agencies are working to improve wildlife connectivity (including grizzly bears) across B.C. Highway 3 in the Rocky Mountains. Efforts include private land conservation by land trusts within identified linkage corridors, conflict mitigation efforts through WildSafe B.C. and the B.C. COS, and recent updated mitigation planning (Lee *et al.* 2019). A wildlife fencing program is being initiated to funnel wildlife into existing small highway crossing structures and underpasses and a larger wildlife crossing structure is being planned (C. Lamb, pers. comm.). Although, to our knowledge, there are no empirical data evaluating connectivity as a result of these activities, we believe they are likely positive initiatives for grizzly bear connectivity in this region.

South Rockies GBPU

North of B.C. Highway 3 in the Rocky Mountains is the South Rockies GBPU (Figure 4 and 19). This unit is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. However, it is also the southern edge of a large area of contiguous grizzly bear habitat that extends 150–175 km (~100 miles) north to the Trans-Canada Highway 1 (Figure 2). As such, this population unit offers genetic and demographic connectivity to bears south of B.C Highway 3. The M2 designation reflects threats to this population including, human-caused mortality primarily on the periphery, and along B.C. Highway 43 that extends north into the unit to Elkford, B.C., extensive forestry roads, high ungulate hunter density and the accompanying mortality.

The South Rocky grizzly bear density is estimated to be 21 bears/1,000 km^2 (170 bears, B.C FLNRORD 2020). Many of the research and conservation efforts mentioned in the Flathead GBPU section above also apply to this unit as B.C. Highway 3 separates the two units and many efforts work to mitigate the human disturbance from this transportation settlement corridor (mentioned above). Grizzly bears in the unit were legally hunted up until the B.C.-wide grizzly bear hunt closure in 2017. As in the South Purcell GBPU, occasionally the combination of non-hunt conflict mortality and the legal hunt exceeded total mortality limits for this population (Artelle *et al.* 2013, Mowat and Lamb 2016). However, the hunt was closed periodically to mitigate the excessive mortalities and allow the bear numbers to recover as per provincial protocol (Hamilton and Austin 2004). The area continues to have significant human-caused mortality issues (Figures 12 and 17, Lamb *et al.* 2016, Mowat and Lamb 2016, Proctor *et al.* 2018). Provincial protected areas account for ~500 km^2 or 6 percent in the northern portion of the GPBU.

The area has several large coal mines (Figure 20) and as a result of conservation concerns a Cumulative Effects Management Framework has been instigated and is currently a cooperative effort between the B.C. FLNRORD and the Ktunaxa Nation Council to inform natural resource decisions (https://www2.gov.bc.ca/gov/content/environment/natural-resource-

stewardship/cumulative-effects-framework/regional-assessments/kootenay-boundary/elk-valley-cemf).

In summary, the conservation situation of the combined Flathead and South Rockies GBPUs is dominated by the fact that south of B.C. Highway 3, the biological population including bears from B.C., Alberta, and the U.S. number more than1,200 bears, many of which live in protected areas. In both Canada and the U.S., bears in the Rocky Mountains north and south of B.C. Highway 3 represent a potential source of bears for the Yahk/Yaak populations. In that regard, both efforts to minimize conflict-related human-caused mortality on the periphery of these GBPUs is warranted. All indications suggest that there is significant room for improvement in this regard. Also, road management is warranted in some areas to allow survival of inter-population migrants.

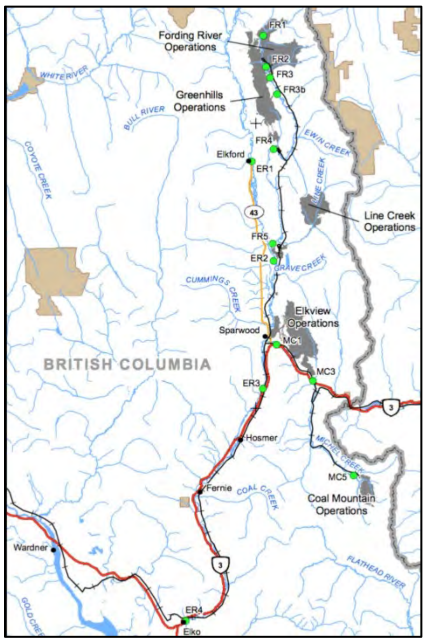

Figure 20: Coal mines in the Flathead Elk Valleys in southeast British Columbia.

British Columbia

Summary

While perfect evidence is often lacking, it appears that connectivity across B.C. Highway 3 and 3A across southern B.C. is increasing, at least in some locations (Tables 1, 2). This is not likely the case in the North Cascades or the Granby Kettle GBPUs, but that possibility exists in the Granby-Kettle if population numbers continue to expand within that GPBU as they have over past 2 decades (Lamb *et al.* 2018). Highway 3 in the Granby-Kettle has virtually no human-settlement and likely would allow grizzly bear permeability. However, for this to occur it might require a unit-wide motorized access management plan be implemented that allowed for increased numbers of bears (OAG 2017, Proctor *et al.* 2021b).

Connectivity to U.S. grizzly bear populations has the most to gain from the Canadian portions of the South Selkirk and Yaak Recovery zones. For this to be realized, connectivity must be further improved across B.C. Highways 3 and 3A, to the larger Purcell grizzly bear population to the north. Connectivity into the South Selkirks across B.C. Highway 3A and across B.C. Highway 3 into the Canadian Yahk (fully connected to the CYE RZ) from the South Purcell Mountains is increasing (Proctor *et al.* 2018), and challenges predicting the future aside, is likely to continue improving. The same can be said for connectivity across B.C. Highway 3 in the Rocky Mountains north of the NCDE. Higher densities of bears in that area provide more possibilities for enhanced connectivity, but continued efforts to reduce human-caused mortality should be a priority. In other words, while the connectivity situation in Canada is improving, more work is required.

Table 1: Summary of trends in connectivity and abundance of Grizzly Bear Population Units in Southern B.C just north of the U.S. border.

	Trend	
GBPU	Connectivity	Abundance
North Cascades	No	No
Granby Kettle[1]	Unknown	Increasing
South Selkirk[2]	Increasing	Increasing
Yahk[2]	Increasing	Unknown
Flathead[3]	Unk, possibly increasing	Stable

[1] Lamb *et al.* (2018)
[2] Proctor *et al.* (2018)
[3] McLellan (2015)

Table 2: Summary of conservation management being applied within Grizzly Bear Population Units in southern B.C. just north of the U.S. border (access mgt refers to motorized management)

	Conservation management to improve:		Specific mgt actions		
GBPU	Connectivity	Population size	Non-lethal conflict response	Access mgt	Attractant mgt
North Cascades	No	No	No	No	No
Granby Kettle	No	Some access mgt	Some	Some	Yes
South Selkirk	Yes	Considerable	Yes	Some	Yes
Yahk	Yes	Some	Yes	No	Yes
Flathead	Some	Some access mgt	Some	Some	Yes

Abundance

Minimizing human-caused mortality and maintaining stable grizzly bear populations in Canada is also beneficial for the shared international populations. We summarize grizzly bear abundance trends in Table 1. There has been no recovery of grizzly bears in the North Cascades in the past 20 years. The Granby-Kettle has experienced a significant increase in bears in the past 20 years and further increases may require a unit-wide motorized access management plan (Lamb *et al.* 2018). Preliminary indications are that bears in the Canadian South Selkirk population are increasing (Kasworm *et al.* 2020a) and human-caused mortality is on a downward trend (Proctor *et al.* 2018). Further increases may also require more widespread access management beyond NCC lands within this unit (MacHutchon and Proctor 2016, Proctor *et al.* 2020, 2021b). An ongoing DNA survey (began in 2020) will verify this within 2021. The population trend in the Canadian Yahk is less clear, except that the international Yahk/Yaak has recently shown to be increasing – how much of that is due to Canadian bears is uncertain. Road densities remain relatively high in the Canadian Yahk and this is where conservation effort needs to focus in this population (Proctor *et al.* 2020, 2021). The Flathead has a relative high density of bears, relative to neighbouring GBPUs, and has undulated over the decades around what might be considered a stable mean over time (McLellan 2015).

Motorized Access Management

Managing backcountry motorized vehicle access remains a challenge in B.C. While several localised motorized access management plans are being implemented (mentioned above), none of them have set targets to meet. Further, despite compelling evidence detailing the benefits of motorized access management to grizzly bear conservation and continued recommendations by scientists to implement a robust motorized access management plan (e.g., Boulanger and Stenhouse 2014, Lamb *et al.* 2018, Proctor *et al.* 2020, Proctor *et al.* 2021b), there is currently no region-wide plan – nor are there plans to develop one (Garth Mowat, B.C. Provincial Large Carnivore Specialist, FLRNORD, pers. comm.). Overcoming public resistance to motorized vehicle closures on a regional scale is challenging, particularly in the absence of pertinent legislation (OAG 2017).

To further work on motorized access management, the Trans-border Grizzly Bear Project is currently working on an analysis wherein they will use their recent huckleberry 'patches-important-for-grizzly-bears' model (Proctor *et al.* 2021b) as the basis for the development of a proposed motorized access management plan that optimizes the benefit to grizzly bear while simultaneously minimizing inconvenience to people. This work is informed by the literature review in Proctor *et al.* (2020) and recent results of Proctor *et al.* (2021b) that demonstrate that huckleberry patches in areas of high road density do not contribute significantly to bear densities. They will use the results of this new project as the basis for conversations with government officials with the goal of furthering the completion of motorized access controls in the South Selkirk, Yahk, and South Purcell GBPUs.

One final note, it is clear from the situation in British Columbia that the U.S. recovery ecosystems would benefit significantly from continued cooperation and collaboration with researchers, ENGOs, First Nations, and governments in Canada, but Canadian populations are

not a panacea for recovery of populations in the U.S. along the Canadian border. The Yahk and South Selkirk populations are small physically as a result of mountain valleys and human transportation and settlement patterns. These physical limitations necessitate that these small populations become and remain connected to adjacent and larger populations over the long-term. That connectivity will not likely be a free flow of bears, but rather a limited number of individuals that move and survive through the human-dominated landscapes that make up the fractures. Thus, while it is essential that the smaller U.S. populations remain connected to Canadian populations, that connectivity is a hedge against loses of genetic diversity, an opportunity for natural demographic rescue and augmentation, and, in the extreme, a resistance against extirpation. The ultimate health of the bears in U.S. ecosystems, and those in Canada also requires that they be healthy populations internally, attained through minimized human-caused mortality and good habitat management.

Alberta Overview

Alberta is the eastern edge of grizzly bear distribution in western Canada (excluding territories north of the 60th parallel) (COSEWIC 2012). Primary grizzly bear habitat includes the Rocky Mountain and Foothills Natural Regions as well as the Central Mixwood Subregion of the Boreal Forest Natural Region (COSEWIC 2012). Alberta grizzly bears were first designated as a fur-bearer in 1928, but that changed the subsequent year (1929) when they became a big game animal (Festa-Bianchet 2010). More stringent hunting regulations were established in the 1960s and by 1988 a draw system and hunting quotas were in place (Festa-Bianchet 2010). In 2002, Alberta's Endangered Species Conservation Committee recommended that grizzly bears be designated as *Threatened* on the basis of the species' small population size, slow reproductive rate, increasing human activity in grizzly bear habitats, and limited immigration from populations outside of Alberta (Alberta Sustainable Resource Development 2008). That recommendation, however, was not accepted by the Minister of Sustainable Resource Development (Festa-Bianchet 2010). A recovery team was appointed, a recovery plan was developed, and from 2004 through 2008, a series of DNA-based population inventories occurred across the province (Alberta Sustainable Resource Development 2008, Festa-Bianchet 2010). Also during this time period, a moratorium on grizzly bear hunting was established in 2006 (Festa-Bianchet 2010); the moratorium continues to be in place at the time of this document, although First Nation subsistence hunting is still allowed. Grizzly bears were listed as *Threatened* under Alberta's Wildlife Act in June 2010 (Alberta Environment and Parks 2016). The 2010 grizzly bear status assessment estimates the current total population of grizzly bears in Alberta as 691 plus additional bears in portions Banff and Jasper National Parks (Festa-Bianchet 2010). This estimate is based on the 2004–2008 DNA inventory data, habitat modelling, and expert opinion.

In 2016, Alberta Environment and Parks drafted an updated grizzly bear recovery plan (Alberta Environment and Parks 2016). Although the updated plan has not yet been approved by the Minister, it guides current grizzly bear management in the province. Alberta is divided into six different bear management areas (BMA, Alberta Environment and Parks 2016). Each BMA is further divided into a Recovery Zone and a Support Zone (Figure 21a, Alberta Environment and Parks 2016). The Recovery Zone is the area in which the province intends to recover grizzly bears, while the Support Zone is intended to allow for grizzly bears whose home ranges are not

entirely within the Recovery Zone; management of bear attractants and other sources of human-wildlife conflict in the Support Zone are completed with the intent of supporting the grizzly bear population in the Recovery Zone (Alberta Environment and Parks 2016). Within the Recovery Zone, there are Core and Secondary Zones which inform Recovery Zone management (Figure 21b, Alberta Environment and Parks 2016). The new plan also identifies Habitat Linkage Zones which identify highway corridors where there is a risk of populations becoming more isolated over time (Alberta Environment and Parks 2016). Updated DNA-based population inventories were completed cross the province from 2011–2018; some density and abundance estimates have been released and others are still forthcoming. Updated population estimates for some BMAs suggest a population increase (Stenhouse *et al.* 2015, Morehouse and Boyce 2016). Because an updated provincial estimate has not yet been completed, the population estimate of 691 (plus additional bears in the mountain National Parks) currently guides grizzly bear management (Alberta Environment and Parks 2016). Threats to grizzly bears across the province include anthropogenic habitat alteration, loss of connectivity, and human-caused grizzly bear mortality (Alberta Environment and Parks 2016).

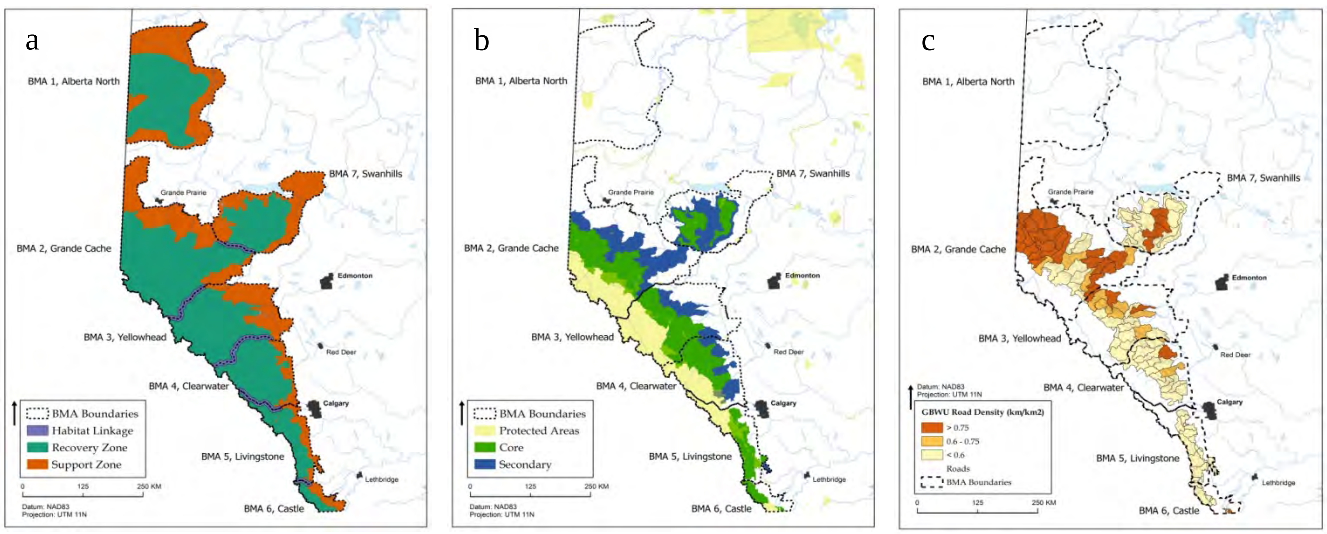

Figure 21: Grizzly Bear Management Areas (BMAs), (b) Core and Secondary habitats (adapted from Nielsen et al. 2009), and (c) Road density categories by Grizzly Bear Watershed Units across 7 BMAs in western Alberta (AEP 2016, adapted from Proctor et al. 2020).

Like many areas of North America, the anthropogenic habitat alteration caused by roads is a primary concern for grizzly bears in Alberta. Roads allow humans motorized access into high-quality grizzly bear habitat (Nielson *et al.* 2004, Schwartz *et al.* 2006), and human-related causes are the primary source of grizzly bear mortality across North America, even in unhunted landscapes (Peek *et al.* 1987, McLellan *et al.* 1999, Benn and Herrero 2002, Garshelis *et al.* 2005, Schwartz *et al.* 2006, McLellan 2015, Proctor *et al.* 2020). Increased road densities are linked to changes in bear movements, distributions, and behaviour; increased mortality risk; and decreased survival and reproduction (Roever *et al.* 2008, Northrup *et al.* 2012a, Boulanger *et al.* 2013, Boulanger and Stenhouse 2014). While road density itself is related to grizzly bear survival, traffic volume is also likely to influence bear behaviour and mortality risk (Northrup *et al.* 2012a, Boulanger and Stenhouse 2014). For example, in southwestern Alberta, grizzly bears use private agricultural lands that have a high road density but lower human use relative to the multi-use public lands (Northrup *et al.* 2012a). In Alberta, demographic models have suggested a road density threshold of 0.75 km/km^2 below which the survival of female grizzly bears with

cubs is reduced (Boulanger and Stenhouse 2014). The current recommended road density thresholds within Alberta's draft recovery plan are 0.6 km/km^2 in the Core Zone and 0.75 km/km^2 in the Secondary Zone (Figure 21c, Alberta Environment and Parks 2016), but there are regional differences in the enactment of these recommendations and there is no province-wide mandate requiring their implementation. Additionally, there is a lack of clarity in terms of what constitutes a closed or restricted road that should be excluded from open-road density calculations (Proctor *et al.* 2020). Further, most BMAs have at least some grizzly bear watershed units that exceed these recommendations (Figure 21c, Alberta Environment and Parks 2016, Proctor *et al.* 2020). Habitat alteration in the form of linear features can also impact grizzly bears. Linear features developed for oil and gas exploration often become recreational trails over time, used by off highway vehicles (OHVs). Ladle's (2017) work suggests that some bears respond negatively to high levels of OHV use on trails. Although closing or restricting motorized access in high quality bear habitat has been identified as a powerful tool in grizzly bear management (Mace *et al.* 1996, Roever *et al.* 2010, Schwartz *et al.* 2010, Northrup *et al.* 2012a, Boulanger and Stenhouse 2014, Proctor *et al.* 2020), there is not currently a provincial motorized access management plan. Access management planning is part of Regional Land Use Plans and it is through that framework that any future motorized access management will be implemented (Alberta Environment and Parks 2016). Although portions of Alberta's BMAs are subject to varying motorized access management plans as part of a protected area designation or a Public Land Use Zone, these plans do not necessarily include the recommended grizzly bear road density thresholds (Alberta Environment and Parks 2016). Indeed, one of the recommended recovery actions within the current draft recovery plan is that grizzly bear road density thresholds be incorporated into regional access management planning (Alberta Environment and Parks 2016).

Loss of connectivity between grizzly bear populations is also a concern at the provincial level. Proctor *et al.* (2012) demonstrated that major east-west highways in Alberta have resulted in differentiation in the genetic structure of bear populations; this genetic separation is greater than the effect of the continental divide separating Alberta and British Columbia. Highway 1 which bisects Banff National Park and Highway 3 through the Crowsnest Pass are particularly problematic (Proctor *et al.* 2012). To address the connectivity concern for wildlife, Banff National Park has installed 6 overpasses and 38 underpasses since 1996 (Ford *et al.* 2010). Research has shown both male and female grizzly bears use these highway crossing structures and there is evidence of bidirectional gene flow across the highway (Sawaya *et al.* 2014). In southwestern Alberta, Highway 3 bisects several small communities that collectively make up the Crowsnest Pass. Several groups are currently working collaboratively to try and develop crossings structures for Highway 3 (https://y2y.net/work/hot-projects/highway-3-wildlife-friendly/). To date, Alberta Transportation has installed jump-outs and wildlife fencing in the Crowsnest Pass. An underpass and wildlife fencing along Hwy 3 near Rock Creek in southwestern Alberta is included in the 2020 provincial highway budget and both projects are currently in the design stage (Alberta Government 2020). Additionally, there are several attractant management initiatives in the Crowsnest Pass lead primarily by the Crowsnest Pass BearSmart (discussed in more detail below).

Human-caused grizzly bear mortality also threatens grizzly bear populations in Alberta. Provincially, the greatest sources of human-caused mortality in order of prevalence are poaching,

accidental collisions with highway vehicles or trains, self-defence kills, and misidentification of a grizzly bear as a black bear by hunters (Alberta Environment and Parks 2016). Grizzly bear mortality due to trains is particularly problematic in the mountain parks (St. Clair *et al.* 2020). Current provincial recovery objectives are to ensure that the known human-caused mortality rate for grizzly bears is less than or equal to 4 percent of which the female morality rate is less than or equal to 1.2 percent for all BMAs except for the southwestern corner of Alberta (BMA 5 and 6) were the known morality rate is less than or equal to 6 percent and less than or equal to 1.8 percent for female grizzly bears (Alberta Environment and Parks 2016).

Human-grizzly bear conflicts remain a challenge and can result in grizzly bears being translocated or killed. Within Alberta, when an individual has a complaint regarding grizzly bears, they have the option of reporting it to the Fish and Wildlife division of the provincial government. The details of the event are recorded as a text summary in a provincial occurrence database. Complaints are investigated by trained government staff. The government response to grizzly bear occurrences is guided by the provincial grizzly bear response guide (Alberta Government 2016). In most situations, if the bear is not an immediate threat to humans, preventative action is the first response (Alberta Government 2016). Preventative responses can include any of the following: area closure/motorized access restrictions, monitoring, providing educational materials, attractant removal, electric fencing, hazing or aversive conditioning, or hard release of capture bears (Alberta Government 2016). Four main criteria are used to determine the government's response to human-bear conflict, including: age, sex, and reproductive status of the bear, location of the incident (e.g., Recovery Zone vs. Support Zone), the bear's behaviour, and the bear's known conflict history (Alberta Government 2016). Captured bears can be relocated within the same BMA, relocated outside of the BMA, or euthanized. In the case of orphaned cubs, retention in captivity is also an option (Alberta Government 2016). Provincially, captured bears were translocated out of the BMA 87 percent of the time (Alberta Environment and Parks 2016).

South of Highway 3 – BMA 6

BMA 6 is bounded by Highway 3 to the north, British Columbia to the west, Montana to the south, and the approximate edge of grizzly bear habitat to the east (Figure 22). Protected lands in this area include Waterton Lakes National Park, Castle Provincial Park, Castle Wildland Provincial Park, and Beauvais Lakes Provincial Park. The remainder of the public lands are crown land under the jurisdiction of the Alberta government. The Recovery Zone in BMA 6 is 1,814 km^2, while the Support Zone is 1,774 km^2. The Support Zone consists almost exclusively of privately owned lands, which are used predominately for agriculture – both livestock and crop production (Statistics Canada 2006). On the north end of BMA 6 is a Habitat Linkage Zone encompassing the Highway 3 region that divides BMA 5 and BMA 6. Southwestern Alberta is known for its strong winds, and there is a sharp transition from mountainous terrain in the west to prairies and agricultural lands in the east; there are limited foothills.

The grizzly bear population in Alberta's BMA 6 is contiguous with Montana's NCDE grizzly bear population as well as British Columbia's Flathead grizzly bear population. The most current density estimates for males in this BMA are 8.0/1,000 km^2 in the Recovery Zone and 7.1 male/1,000 km^2 in the Support Zone (Morehouse and Boyce 2016). For females, density

estimates are 12.4/1,000 km^2 in the Recovery Zone and 10.0/1,000 km^2 in the Support Zone (Morehouse and Boyce 2016). The expected abundance of resident grizzly bears in BMA 6 is 67.4 (Morehouse and Boyce 2016). These numbers represent a 4 percent per year increase from the previous BMA 6 abundance estimate of 51 grizzly bears (Alberta Grizzly Bear Inventory Team 2008, Morehouse and Boyce 2016). It should be noted, however, that the methods were not identical between the 2007 and 2014 abundance estimates (Alberta Grizzly Bear Inventory Team 2008, Morehouse and Boyce 2016). BMA 6 is a small portion of a much larger ecological population and Morehouse and Boyce (2016) estimated that approximately 172 grizzly bears use the area each year. The area was also sampled in 1997 in conjunction with an additional DNA grid north of Highway 3 (Mowat and Strobeck 2000). The Mowat and Strobeck (2000) abundance was 74 bears (95% CI = 60–100), but the grid sampled a larger area, and the estimates are not directly comparable.

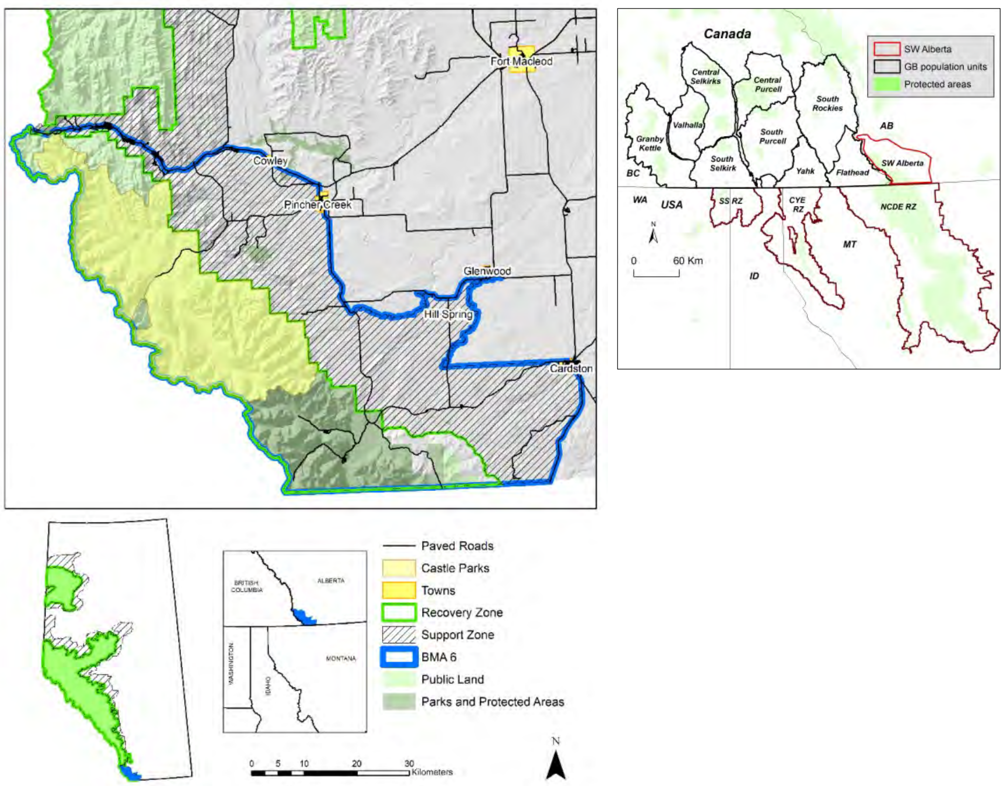

Figure 22: Grizzly bear management unit north of the Canada-U.S. border in southwest Alberta relative to the NCDE Recovery zone.

The Recovery Zone of BMA 6 is a multi-use landscape where uses include oil and gas development, forestry operations, cattle grazing, and several recreational activities (e.g., hiking, mountain biking, camping, OHV use, skiing, etc.). Much of the Recovery Zone has recently (2017) been designated as the Castle Parks (Figure 22, Castle Wildland Provincial Park and Castle Provincial Park), which is likely positive for bears as much of the area within the Recovery Zone has been identified as high-quality habitat for grizzly bears (Nielsen *et al.* 2009, Northrup *et al*. 2012b, Farr *et al*. 2017). Indeed, the Recovery Zone of BMA 6 contains areas of high habitat productivity, including several species of fruiting bear foods (Braid and Nielsen 2015). Although the road density at the watershed scale in the Castle region is relatively low

(average 0.2 km/km^2) and below the suggested grizzly bear threshold of 0.6 km/km^2 (Farr *et al.* 2017), the total average linear footprint density (including off road vehicle trails) of 2.0 km/km^2 is over two times higher than that found in other parks of Alberta (Farr *et al.* 2017). The Castle Management Plan states that it will, "Monitor recreational trail use and, if necessary, limit density and frequency of use to minimize stressors on grizzly bears" (Alberta Environment and Parks 2018). Specific road density thresholds, however, are not included within the plan. Within the entirety of BMA 6, 37.5 percent (3 out of 8) grizzly bear watershed units in the Core Zone have road densities that exceed the recommended road density of 0. 6 km/ km^2. Further, this area has high traffic volumes, and traffic patterns have caused a distinct behaviour shift in grizzly bears with bear use of areas near roads and crossing of roads occurring at night when traffic is low (Northrup *et al.* 2012a, b). As an example of the juxtaposition of good habitat and mortality risk, Braid and Nielsen (2015) identified both source-like habitats (i.e., areas with high habitat productivity and low mortality risk) and sink-like habitats (i.e., areas with high habitat productivity and high mortality risk). They then used simulated annealing to prioritize these sites and identify areas where future development should be limited and road-related mortality risk should be mitigated (Braid and Nielsen 2015). Many of these high priority sites are within the Recovery Zone (Braid and Nielsen 2015). Thus, while the Recovery Region contains important bear habitat, it is not without challenges.

Outside of the Recovery Zone, the Habitat Linkage zone identifies the area of southwestern Alberta where there is a need to maintain or enhance the ability of grizzly bears to move between adjacent BMAs. As noted in the Alberta overview, Highway 3, which bisects the towns of the Crowsnest Pass, represents a barrier to movement for grizzly bears in this region (Proctor *et al.* 2012). Indeed, genetic work has revealed a limited number of bears cross the highway. Population inventory work occurred in the adjacent BMA 5 (north of Highway 3) in 2014 (northern half of BMA 5) and 2016 (southern half of BMA 5). Out of the more than 300 genotypes that were detected in the BMA 5 and BMA 6 inventory work, there were 9 bears (6 M, 3 F) that were detected both north and south of Highway 3 (Morehouse 2018). Of these 9 bears, 2 of them were translocated into BMA 5 from BMA 6 because of conflicts (Morehouse 2018). It is possible that additional bears were translocated between the BMAs and no hair samples were collected; some of the redetections are unlikely as natural movements (Morehouse 2018).

To help address the connectivity issue for grizzly bear, Chetkiewsicz and Boyce (2009) developed resource selection functions for grizzly bears in the Crowsnest and found that grizzly bear habitat selection was positively associated with greenness in all seasons and soil wetness and proximity to water in the summer – and both of these variables were associated with grizzly bear forage. Using these RSFs and least cost path analysis Chetkiewsicz and Boyce (2009) suggested potential highway crossing zones for the Crowsnest Pass. Highway 3 is a barrier for not only grizzly bears, but numerous wildlife species (Apps *et al.* 2007), and several organizations are working together to try and implement crossing structures (Clevenger *et al.* 2010).

In BMA 6, the Support Zone is almost exclusively private lands and there is extensive overlap between grizzly bear home ranges and human land uses (Figure 23, Northup *et al.* 2012b, Farr *et al.* 2017). The private lands of BMA 6 contain favourable grizzly bear habitat and often have lower human use than the adjacent public lands (Northrup *et al.* 2012, Northrup *et al.* 2012b).

However, several attractants exist and the propensity for conflict is higher on private lands (Northrup *et al.* 2012b). Indeed, much of the private land within BMA 6 has been identified as an ecological trap for grizzly bears (Northrup *et al.* 2012). While human-grizzly bear conflicts are a concern across the province, southwestern Alberta is a hotspot (Alberta Environment and Parks 2016, Morehouse and Boyce 2017a). Most grizzly bear incidents in the area are related to some sort of attractant and the primary attractants for grizzly bears are grain and dead livestock (Morehouse and Boyce 2017a). Depredation of livestock is also a concern and depredation events have been increasing in recent years (Morehouse *et al.* 2018, Morehouse *et al.* 2020). Grizzly bear occurrences have also been spreading eastward over the last decade and grizzly bears now occur on prairie habitats outside of the provincially designated BMA boundaries (Figure 23, Morehouse and Boyce 2017a). Research also suggests that conflict behaviours might be being passed down from females to their offspring, potentially exacerbating the human-bear conflict problem (Morehouse *et al.* 2016). As a result of conflicts, grizzly bears can be translocated according to the grizzly bear response guidelines (Alberta Government 2016). Between 2009 and 2013, 42 grizzly bears were captured and translocated outside of BMA 6 – the highest number for the province for that time period (Alberta Environment and Parks 2016).

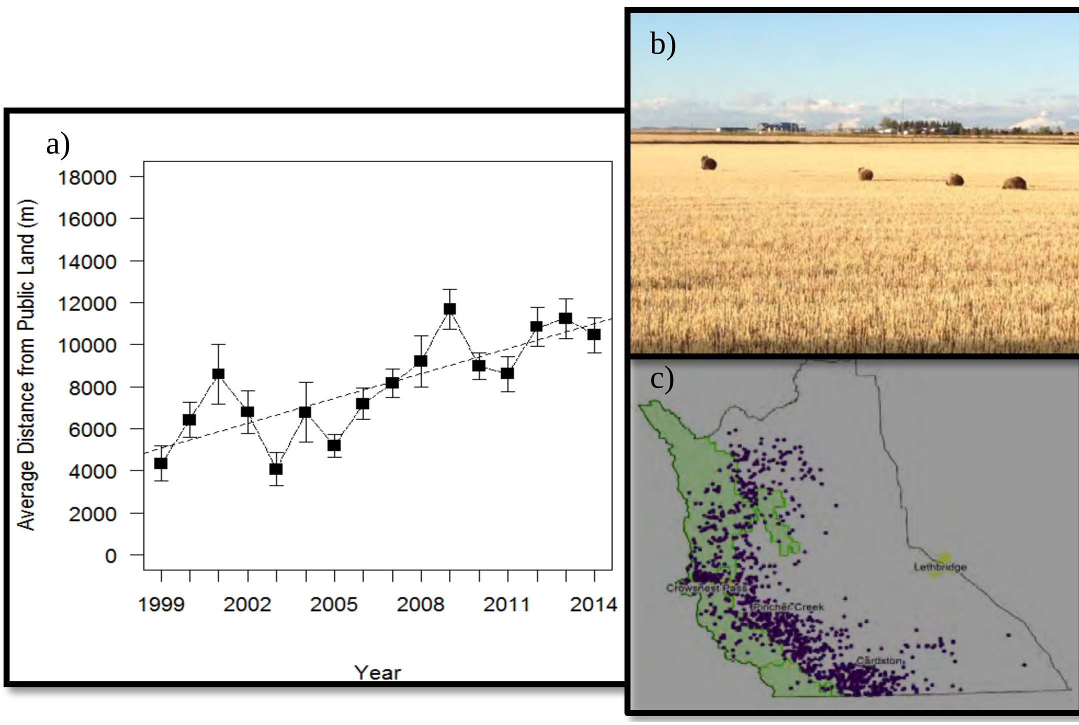

Figure 23: Increasing use of agricultural lands by grizzly bears to the east of the Rocky Mountains and foothills in southwest Alberta. Occurrence records (i.e., complaint data) show an eastward expansion over time (a, c). Photo (b) provided by Lyle Lester, Alberta Solicitor General. Adapted from Morehouse and Boyce (2017).

There are several initiatives in BMA 6 to try and mitigate or reduce human-grizzly bear conflicts including the Crowsnest Pass BearSmart program, the provincial intercept-feeding program, and the Waterton Biosphere Reserve's Carnivores and Communities Program. The Crowsnest Pass BearSmart Program is part of Alberta's provincial BearSmart effort, which aims to provide Albertans with the necessary information to make safe decisions while in bear country, keep bears safe, prevent bear encounters, and reduce bear-caused property damage

(https://www.alberta.ca/alberta-bearsmart-program-overview.aspx). Garbage is one of the primary attractants in the Crowsnest Pass (Morehouse and Boyce 2017a). Although most human-bear conflicts in the Crowsnest Pass are related to black bears, grizzly bears are present as well (Morehouse and Boyce 2017a). The program works on several attractant management initiatives including attractant removal for seniors and other individuals unable to remove attractants such as apples or fruit trees, bear-resistant garbage cans for loan, and partnerships with municipal governments to develop bylaws aimed at assisting and enforcing the reduction of attractants (www.cnpbearsmart.com).

Specific to BMA 6, was the intercept feeding program wherein the provincial government slung road-killed ungulate carcasses into remote high elevation areas where grizzly bears were likely to encounter them once they emerged from hibernation. The program began in 1998 with the goal of reducing grizzly bear depredation of livestock during the spring calving season. Typically, two carcass drops occurred each year, once in mid-March and once in mid-April. Morehouse and Boyce (2017b) evaluated the program using non-invasive genetic sampling, remotely-triggered trail cameras, and provincial complaint records. They found that the program was used largely by male grizzly bears and that grizzly bear depredation of livestock did not decrease during the intercept-feeding program nor did it increase after the program was suspended (Morehouse and Boyce 2017b). Annual operating costs for the program were estimated to be $43,850 CAD with an initial $19,000 CAD investment (Morehouse and Boyce 2017b). Thus, their results suggested that other mitigation efforts such as electric fencing of calving pastures might be a more cost-effective long-term solution (Morehouse and Boyce 2017b).

Perhaps the most active human-bear conflict mitigation initiative in BMA 6 is the Waterton Biosphere Reserve's (WBR) Carnivores and Communities Program (CACP). The program works with landowners, farmers, ranchers and rural residents to advance its goal of supporting coexistence between people and large carnivores. The program began in 2009 and the Alberta government is one of its primary funders and partners. The CACP has three primary on-the-ground initiatives: deadstock removal, cost-shared attractant management projects, and bear safety workshops. The deadstock removal program provides a direct service to livestock producers whereby livestock carcasses are picked up and completely removed from the property. Cost-shared attractant management projects are things such as electric fencing, bear-resistant grain bin doors, and upgraded grain storage that restrict bear access to agricultural attractants. Grain and deadstock are the primary bear attractants in this area (Morehouse and Boyce 2017a).

Finally, bear safety workshops have been developed in partnership with the Alberta government to specifically target farm and ranch families. The efficacy of the CACP was recently evaluated using a social survey and review of complaint records; both attractant and deadstock-based grizzly bear incidents changed from increasing to decreasing after the implementation of the CACP program in 2009; livestock depredation by grizzly bears, however, remains a challenge (Figure 24, Morehouse *et al.* 2020).

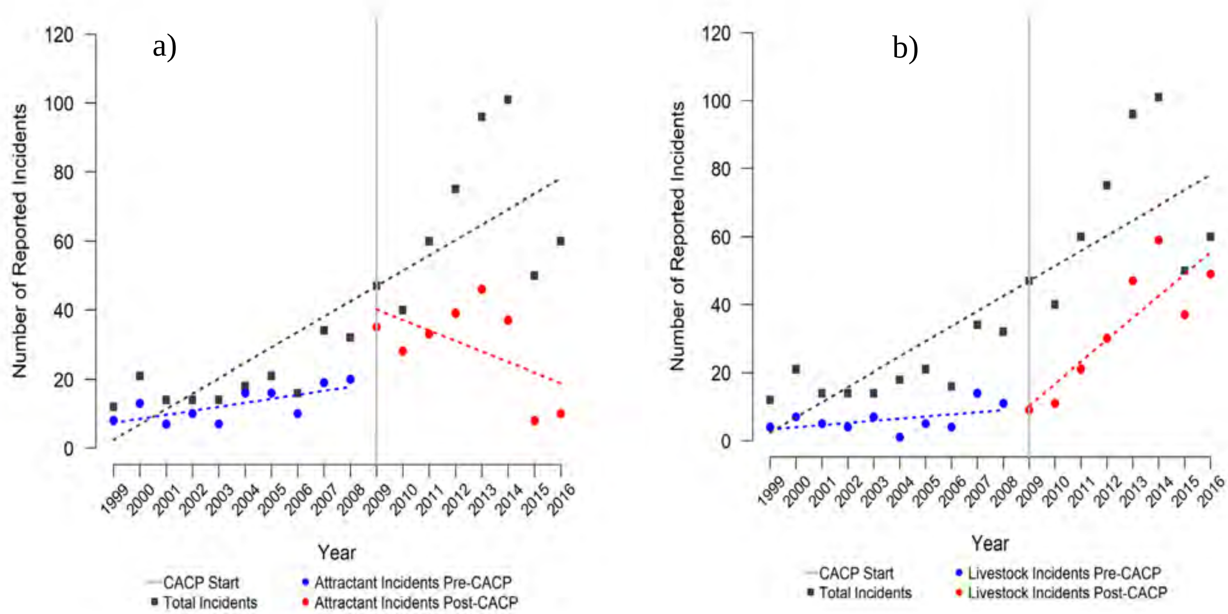

Figure 24: Reported grizzly bear attractant (a) and livestock (b) incidents before and after the implementation of conflict reduction management by th Waterton Biosphere Reserve's Carnivores and Communities Program (CACP) in southern Alberta which started in 2009. Adapted from Morehouse e al. (2020).

Yukon, Northwest Territories, and Nunavut

There are approximately 11,500–14,000 grizzly bears within Canada north of the 60th parallel in North America (Figure 1. Yukon, 6,000–7,000, Northwest Territories 4,000–5,000, Nunavut 1,500–2,000, COSEWIC 2012). Grizzly bear populations in this region are generally sustainable and appear to be expanding north into the islands of the Arctic Ocean (Figure 1, McLellan *et al.* 2017b). Bears are legally hunted in several local jurisdictions where habitat productivity is sufficient for a sustainable hunt (Yukon Conservation and Management Plan Working Group 2019). While human population densities are very low relative to southern Canada, grizzly bears are still susceptible to human disturbance and conflict mortality. As such, each territory has conflict reduction and human safety guidelines for living and working with bears (Yukon Conservation and Management Plan Working Group 2019, NWT, https://www.enr.gov.nt.ca/en/services/bear-safety). The distance between the bears in the lower-48 States and these northern populations is such that there is no link between them in terms of connectivity, genetic or demographic (Proctor *et al.* 2012).

Alaska

Grizzly bears, or brown bears as they are often called in Alaska, occupy most of Alaska except several islands along the southeast coast, the furthest portions of the Aleutian Island chain, and the lower reaches of the Yukon River in extreme southwest Alaska (Figure 1). Grizzly bear densities in Alaska range widely from more than 175 bears/1,000 km^2 in coastal populations where salmon are the primary food, to less than 40 bears/1,000km^2 in interior populations, to less than 7 bears/1,000km^2 in northern coastal plains areas (Miller & Schoen 1999). This variation in

bear density is thought to be related to a region's bear food productivity (Hilderbrand *et al.* 1999, 2019, Mowat *et al.* 2013). Alaska has the largest grizzly bear population of any jurisdiction in North America (Figure 1, Miller and Schoen 1999). While a state-wide rigorous estimate of abundance is not available, manager and expert-derived estimates suggest there may be between 25,000 – 39,000 bears and, state-wide, the population is considered to be stable in abundance and distribution (Miller and Schoen 1999). That said, there are localized issues with conflict and hunt controversies (Peirce and Van Daele 2006, Miller *et al.* 2017).

Alaska is home to the only other sub-species of brown bear in North America – the bears of Kodiak Island (*Ursus arctos middendorffi*), of which there are an estimated 3,500 (Rausch 1963, Talbot and Shields 1996, Paetkau *et al.* 1998a and b, Alaska Department of Fish and Game https://www.adfg.alaska.gov/index.cfm?adfg=brownbear.trivia). Kodiak's brown bears have been isolated from the mainland for approximately 12,000 years and have a relative low genetic diversity but show no negative population attributes due to inbreeding depression (Paetkau *et al.* 1998a and b).

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Appendix F. Winter Recreation

Grizzly bears are easily awakened in the den (Schwartz *et al.* 2003a, p. 567), and it is important to consider the potential impact from winter recreation. Disturbance of grizzly bears in the den can result in cub abandonment or early den exit, which could kill a grizzly (if they leave before food is readily available). However, information regarding impacts of winter recreation on grizzly bears is limited. We found no studies in the peer-reviewed literature documenting the effects of snowmobile use on any denning bear species and no records of litter abandonment by grizzly bears in the lower-48 States due to snowmobiling; the information that is available is based on opportunistic sightings and small sample sizes (in their entirety: Service 2002; Hegg *et al.* 2010). The one documented observation of snowmobiling at a known den site in the lower-48 States found the bear did not abandon its den, even though snowmobiles were operating directly on top of it (Hegg *et al.* 2010, p. 26). This, however, is only an opportunistic observation and is based on a sample size of one. We found no records of litter abandonment or den abandonment by grizzly bears in the lower-48 States due to snowmobiling activity (in their entirety: Service 2002; Hegg *et al.* 2010; Roberts 2018, *in litt.*).

Swenson *et al.* (1997, entire) monitored 13 male and female grizzly bears in Scandinavia for at least 5 winters each and documented 18 instances of den abandonment, 12 of which were related to human activities. Four of these instances were hunting related (i.e., gunshots fired within 100 m (328 ft) of the den), two occurred after "forestry activity *at* the den site," one had moose and dog tracks within 10 m (33 ft) of a den, one had dog tracks *at* the den site, one had ski tracks within 80 to 90 m (262 to 295 ft) from a den, one had an excavation machine working within 75 m (246 ft) of a den, and two were categorized as "human related" without further details (Swenson *et al.* 1997, p. 37). Swenson *et al.* (1997) found that most den abandonment (72 percent) occurred early in the season before pregnant females give birth. However, there still may be a reproductive cost of these early den abandonments: 60 percent (sample size of 5) of female bears that abandoned a den site before giving birth lost at least one cub whereas only 6 percent (sample size of 36) of pregnant females that did not abandon their dens lost a cub in or near their den (Swenson *et al.* 1997, p. 37).

There are no data or information suggesting winter recreational use is negatively affecting grizzly bear populations in the lower-48 States, yet because the potential for disturbance and impacts to reproductive success exists, monitoring will continue to support adaptive management decisions about winter recreation use in areas where disturbance is documented or likely to occur.

Inside the GYE

In the GYE, the one documented observation of snowmobile use at a known den site found the bear did not abandon its den, even though snowmobiles were operating directly on top of it (Hegg *et al.* 2010, p. 26). Additionally, monitoring of den occupancy for 3 years on the Gallatin NF in Montana did not document any den abandonment (USDA FS 2006c, entire). In one rare instance of possible den disturbance, four backcountry skiers in GTNP reported seeing a collared grizzly bear close to where he had been denned three weeks earlier based on VHF locations from flights (Gustine 2019, *in litt.*). Of the 479 grizzly bear mortalities that occurred between 2002

and 2018, only 2 occurred between 1 December and 28 February. One of the mortalities was a radio-collared, 20-year-old male that died in January from natural causes in YNP, most likely from maladies associated with old age. The second mortality was a collared individual that likely died in an avalanche.

The Forest Plan Amendment includes guidance that, inside the recovery zone, localized area restrictions are to be used to mitigate any conflicts during denning or after bear emergence in the spring. Bears tend to den in remote areas with characteristics that are not conducive to snowmobiling (i.e., steep, forested habitats). Suitable denning habitat is well distributed on the forests, and much of the general grizzly bear denning habitat identified in the Forest Plan Amendment Final EIS as being open to snowmobiling is not actually used by snowmobiles because of its steep and forested nature (USDA FS 2006a, p. 92). For example, 85.2 percent of the known dens in the GYE are located in areas where snowmobile use does not occur and, of the 13.9 percent of dens that do occur in areas open to snowmobiling, only 0.8 percent are classified as high potential for snowmobile use (Haroldson 2017, *in litt.*).

Inside the NCDE

Bears tend to den in remote areas with characteristics that are not conducive to snowmobiling (i.e., steep, forested habitats). Suitable denning habitat is well distributed on the forests, and under current forest plans, approximately 6 percent of USFS lands are both open for snowmobiling and are modeled denning habitat (Ake 2019b, *in litt.*). Forest Plans within the NCDE include direction that, inside the recovery zone, there will be no net increase in the area or miles or routes designated for over-snow vehicle use during the den emergence period (USDA FS 2018a, p. 181; USDA FS 2018b, p. 15). This measure will reduce the potential impacts to females with cubs whom have high energetic costs and often spend several days to a few weeks near the den after emergence. In addition, snowmobiling is not allowed inside Glacier National Park or in designated Wilderness on USFS lands, which constitutes approximately 34 percent of the recovery zone.

Inside the CYE, SE, BE, and North Cascades

There have been no documented cases of grizzly bears abandoning dens as a result of snowmobiling or other winter recreational activities in the CYE or SE (Kasworm 2018a, *in litt.*). The BE and North Cascades have not had a known population in recent decades.

Appendix G. Pre-2002 Grizzly Bear Mortality Summary

Table 1. Causes of grizzly bear mortalities in the GYE 1980–2001. This table includes all known and probable mortalities of independent-age bears and dependent young, as displayed in parenthesis (), inside and outside the demographic monitoring area (DMA).

GYE Grizzly Bear Mortality, 1980–2001						
	Inside DMA			**Outside DMA**		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalitie s**	**Avg./ year**	**Percent total**
Natural	17 (27)	0.8 (1.2)	9 (51)	0 (0)	0.0 (0.0)	0 (0)
Undetermined	17 (3)	0.8 (0.1)	9 (6)	1 (0)	0.0 (0.0)	10 (0)
Human-caused	147 (23)	6.7 (1.0)	81 (43)	9 (2)	0.4 (0.1)	90 (100)
Total mortalities	**181 (53)**	**8.2 (2.4)**		**10 (2)**	**0.5 (0.1)**	
Human-caused mortalities	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalitie s**	**Avg./ year**	**Percent of human-caused**
Accidental						
Automobile collision	5 (2)	0.2 (0.3)	3 (9)	0 (0)	0.0 (0.0)	0 (0)
Capture related	5 (5)	0.2 (0.2)	3 (22)	0 (0)	0.0 (0.0)	0 (0)
Drowning	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Poisoning	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Electrocuted	5 (0)	0.2 (0.0)	3 (0)	0 (0)	0.0 (0.0)	0 (0)
Defense of life	39 (7)	1.8 (0.3)	27 (30)	1 (0)	<0.1 (0.0)	11 (0)
Illegal *	36 (3)	1.6 (0.1)	24 (13)	0 (0)	0.0 (0.0)	0 (0)
Management removal						
Site conflicts/Human safety**	42 (6)	2.0 (0.3)	31 (26)	8 (2)	0.4 (0.1)	89 (100)
Injured or diseased bear	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Livestock depredation	3 (0)	0.1 (0.0)	2 (0)	6 (0)	0.3 (0.0)	67 (0)
Mistaken identification***	12 (0)	0.5 (0.0)	8 (0)	0 (0)	0.0 (0.0)	0 (0)

* Illegal includes poaching, malicious, and defense of property kills.

** Site conflicts/human safety include anthropogenic food and property damage related management removals in the front- and backcountry.

***Mistaken identification includes grizzly bear kills over bait. Four instances of bears killed over bait are included.

Table 2. Causes of grizzly bear mortalities in the NCDE 1980–2001. This table includes all known and probable mortalities of independent-age bears and dependent young, as displayed in parenthesis (), inside and outside the demographic monitoring area (DMA).

NCDE Grizzly Bear Mortality, 1980–2001						
	Inside DMA			**Outside DMA**		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	10 (12)	0.4 (0.4)	3 (15)	0 (0)	0.0 (0.0)	0 (0)
Undetermined	8 (2)	0.3 (<0.1)	2 (2)	0 (0)	0.0 (0.0)	0 (0)
Human-caused	357 (68)	13.2 (2.5)	95 (83)	7 (0)	0.3 (0.0)	100 (0)
Total mortalities	**375 (82)**	**13.9 (3.0)**		**7 (0)**	**0.3 (0.0)**	
Human-caused mortalities	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental						
Automobile collision	5 (1)	0.2 (<0.1)	1 (2)	0 (0)	0.0 (0.0)	0 (0)
Capture related	11 (7)	0.4 (0.3)	3 (10)	0 (0)	0.0 (0.0)	0 (0)
Drowning	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Poisoning	2 (0)	<0.1 (0)	<1 (0)	1 (0)	<0.1 (0.0)	14 (0)
Train collision	15 (15)	0.6 (0.6)	4 (22)	0 (0)	0.0 (0.0)	0 (0)
Defense of life	23 (3)	0.9 (0.1)	6 (4)	0 (0)	0.0 (0.0)	0 (0)
Illegal *	78 (17)	2.9 90.6)	22 (25)	2 (0)	<0.1 (0.0)	29 (0)
Legal hunting	124 (6)	4.6 (0.2)	35 (9)	0 (0)	0.0 (0.0)	0 (0)
Management removal						
Augmentation**	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Site conflicts/Human safety***	54 (13)	2.0 (0.5)	15 (19)	0 (0)	0.0 (0.0)	0 (0)
Injured or diseased bear	1 (1)	<0.1 (<0.1)	<1 (2)	0 (0)	0.0 (0.0)	0 (0)
Livestock depredation	19 (2)	0.7 (<0.1)	5 (3)	3 (0)	0.1 (0)	43 (0)
Mistaken identification	22 (2)	0.8 (<0.1)	6 (3)	1 (0)	<0.1 (0)	14 (0)
Unknown	3 (1)	0.1 (<0.1)	<1 (2)	0 (0)	0.0 (0.0)	0 (0)

* Illegal includes poaching, malicious, and defense of property kills.

** When bears are relocated from the NCDE to augment the CYE population, they are counted as mortalities in the NCDE.

*** Site conflicts include both anthropogenic food and property damage related management removals. Human safety includes incidents in both the front and backcountry.

Table 3. Causes of known and probably grizzly bear mortalities from 1982 to 2001 in the CYE and the U.S. portion of the SE. Mortalities in the CYE and SE include apply within the recovery zone plus a 10-mile buffer, excluding Canada.

CYE and SE Grizzly Bear Mortality, 1982–2001						
	CYE			SE		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	7	0.4	33	3	0.2	19
Unknown/undetermined	1	<0.1	5	1	<0.1	6
Human-caused	13	0.7	62	12	0.6	75
Total mortalities	**21**	**1.1**		**16**	**0.8**	
Human-caused mortalities*	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental	2	0.1	15	0	0.0	0
Defense of life	2	0.1	15	0	0.0	0
Illegal poaching	3	0.2	23	4	0.2	33
Management removal	1	<0.1	8	0	0.0	0
Mistaken identification	3	0.2	23	2	0.1	17
Unknown**	2	0.1	15	6	0.3	50

* Orphaned dependent offspring were classified according to cause of death of their mother.
** Includes mortalities that are under investigation.

In addition, there were two known human-caused mortalities inside the lower-48 States outside of these areas; one unknown and one mistaken identification.

CABINET-YAAK GRIZZLY BEAR RECOVERY AREA 2020 RESEARCH AND MONITORING PROGRESS REPORT

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2021

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This annual report is cumulative and represents data collected, reanalyzed and summarized annually since the inception of this monitoring program in 1983. Information in this report supersedes previous reports. Please obtain permission prior to citation. Cite as follows: **Kasworm, W. F., T. G. Radandt, J. E. Teisberg, T. Vent, A. Welander, M. Proctor, H. Cooley and J. K. Fortin-Noreus. 2021. Cabinet-Yaak grizzly bear recovery area 2020 research and monitoring progress report. U.S. Fish and Wildlife Service, Missoula, Montana. 108 pp.**

ABSTRACT

Eleven grizzly bears were monitored with radio-collars during portions of 2020. Research monitoring included four females (three adults and one subadults) and seven males (one adult and six subadults) in the Cabinet-Yaak Ecosystem (CYE). Two subadult males and a subadult female were from the Cabinet Mountains augmentation program. One subadult male bear was collared for conflict management purposes. Grizzly bear monitoring and research has been ongoing in the Cabinet Mountains since 1983 and in the Yaak River since 1986. Eighty-two individual resident bears were captured and monitored through telemetry in the two areas from 1983–2020. Research in the Cabinet Mountains indicated that only a small population remained as of 1988. Concern over persistence of grizzly bear populations within this area resulted in a pilot program in 1990 that tested population augmentation techniques. Four subadult female bears with no history of conflicts with humans were captured in southeast British Columbia for release in the Cabinet Mountains during 1990–1994. Three of four transplanted bears remained within the target area for at least one year. Hair snag sampling and DNA analysis during 2000–2004 identified one of the original transplanted bears. The animal was a 2-year-old female when released in 1993. Genetic analysis conducted in 2005 identified at least three first-generation offspring and two second-generation offspring from this individual. Success of the augmentation test program prompted additional augmentation in cooperation with Montana Fish, Wildlife, and Parks (MFWP). Ten female bears and eight male bears were moved from the Flathead River to the Cabinet Mountains during 2005–2020. Four of these individuals died during their first year from human related causes. Two were illegally shot, one was struck by a train, and one was killed in self-defense. Eight bears left the target area for augmentation, but three returned.

Numbers of females with cubs in the CYE varied from 2–5 per year and averaged 3.3 per year, 2015–2020. Thirteen of 22 bear management units (BMUs) had sightings of females with young. Human caused mortality averaged 1.5 bears per year (0.5 female and 1.0 male), 2015–2020. Nine grizzly bears (3 females and 6 males) died due to known or probable human causes during 2015–2020, including 3 adult females (2 under investigation, 1 self-defense), 2 adult males (1 under investigation and 1 management), 4 subadult males (1 each self-defense, human under investigation, mis-identification, and poaching).

Using all methods (capture, collared individuals, rub tree DNA, corral DNA, opportune DNA sampling, photos, credible observations), we detected a minimum 50 individual grizzly bears alive and in the CYE grizzly bear population at some point during 2019. Five of these bears were known dead. Twenty-three bears were detected in the Cabinets (16 male, 7 female). Twenty-seven bears were detected in the Yaak (16 male, 7 female, 4 unknown sex).

Sex- and age-specific survival and reproductive rates yielded an estimated finite rate of increase (λ) of 1.017 (95% C.I. = 0.935–1.090) for 1983–2020 using Booter software with the unpaired litter size and birth interval option. Finite rate of population change was an annual 1.7% for 1983–2020. The probability that the population was stable or increasing was 60%.

Berry counts indicated above average production for huckleberry, buffaloberry, and mountain ash and average production for serviceberry during 2020.

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INTRODUCTION

Grizzly bear (*Ursus arctos*) populations south of Canada are currently listed as Threatened under the terms of the 1973 Endangered Species Act (16 U.S.C. 1531-1543). In 1993 a revised Recovery Plan for grizzly bears was adopted to aid the recovery of this species within ecosystems that they or their habitat occupy (USFWS 1993). Seven areas were identified in the Recovery Plan, one of which was the Cabinet-Yaak Grizzly Bear Recovery Zone (CYE) of extreme northwestern Montana and northeast Idaho (Fig. 1). This area lies directly south of Canada and encompasses approximately 6800 km^2. The Kootenai River bisects the CYE, with grizzly bear habitat within the Cabinet Mountains to the south and the Yaak River drainage to the north (Fig. 2). The degree of grizzly bear movement between the two portions was believed to be minimal but several movements by males into the Cabinet Mountains from the Yaak River and the Selkirk Mountains have occurred since 2012.

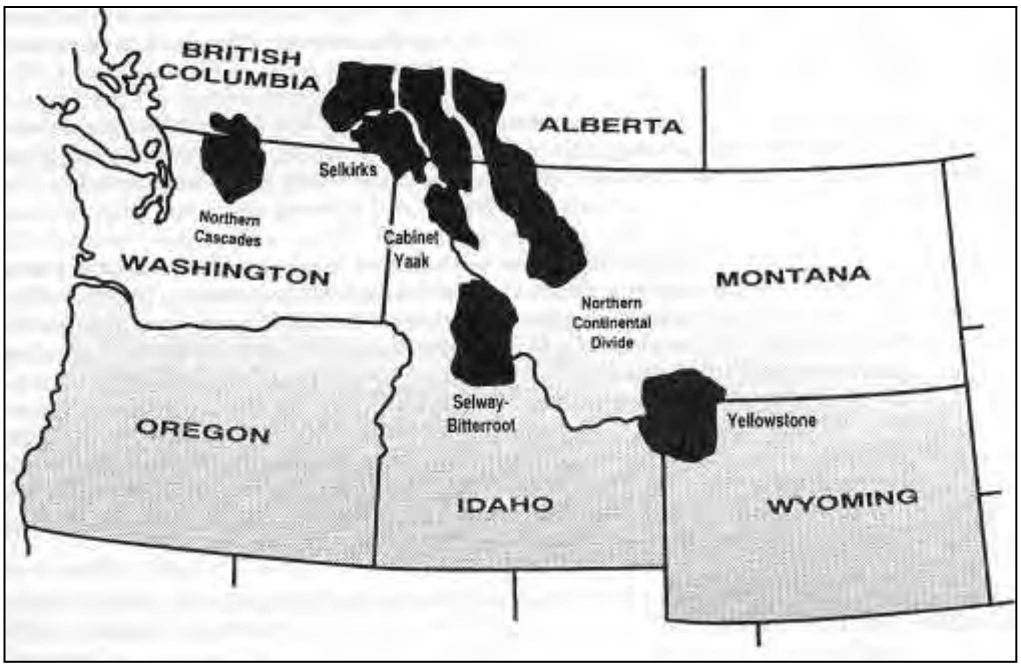

Figure 1. Grizzly bear recovery areas in the U.S., southern British Columbia, and Alberta, Canada.

Research on resident grizzly bears began south of the Kootenai River during the late 1970's. Erickson (1978) reported the results of a survey he conducted for bears and their sign in the Cabinet Mountains and concluded the population consisted of approximately a dozen animals. A trapping effort in 1979 and 1980 in the same area failed to capture a grizzly bear, but a female and yearling were observed (Thier 1981). In 1983 trapping efforts were resumed and intensified (Kasworm and Manley 1988). Three individual grizzly bears were captured and radio-collared during 1983–1987. Minimal reproduction was observed during the period and the population was believed to be declining toward extinction. To reverse this trend, a formal plan was proposed in 1987 to augment the Cabinet Mountains portion of the population with subadult female bears from outside the area (USFWS 1990, Servheen *et al*. 1987).

Two approaches for augmenting grizzly bears were proposed. The first involved transplanting adult or subadult grizzly bears from other areas of similar habitat to the Cabinet

Mountains. Transplants would involve bears from remote areas that would have no history of conflict with humans. The use of subadult females was recommended because of their smaller home ranges and potential reproductive contribution. The second approach relied on the cross fostering of grizzly bear cubs to American black bear (*Ursus americanus*) females. Under this approach, grizzly bear cubs from zoos would be placed in the maternal dens of black bear females during March or April. The fostering of orphaned black bear cubs to surrogate black bear females has been used successfully in several areas (Alt and Beecham 1984, Alt 1984).

During public review of the augmentation program, many concerns were expressed which included human safety, conflicts with other land-uses, and long-term grizzly bear population goals. A citizen's involvement committee was formed to aid information exchange between the public and the agencies. Representatives of several local organizations donated their time to further this purpose. The first product of this group was a question-and-answer brochure regarding grizzly bears in the CYE. This brochure was mailed to all box holders in Lincoln and Sanders counties. In response to concerns expressed by the committee, the augmentation proposal was modified to eliminate cross fostering and to reduce total numbers of transplanted bears to four individuals over five years. The beginning date of augmentation was also postponed for one year to allow additional public information and education programs.

Prior to 1986, little work was conducted on grizzly bears in the Yaak River portion of the CYE. Bears that used the area were thought to be largely transitory from Canada. However, a black bear study in the Yaak River drainage in 1986 and 1987 resulted in the capture and radio-collaring of five individual grizzly bears (Thier 1990). The Yaak River area has traditionally been an important source of timber for area mills, with timber harvesting the dominant use of the area. A pine beetle (*Dendroctonus ponderosae*) epidemic began in the mid 1970's. Large stands of lodgepole pine (*Pinus contorta*) were infected, which resulted in an accelerated timber-harvesting program with clearcutting the dominant silvicultural technique. A concern of environmental degradation, as well as the effects of timber harvesting on the local grizzly bear population, prompted a lawsuit against the Forest Service by a local citizen's group in 1983 (USFS 1989). To obtain additional information on the population status and habitat needs of grizzly bears using the area, the U.S. Forest Service and Montana Fish, Wildlife and Parks (MFWP) cooperated with the U.S. Fish and Wildlife Service (USFWS) initiating a long-term study. Field work began in June of 1989.

A population viability analysis recommended four areas of emphasis in future management for recovery of this population (Proctor *et al*. 2004). Those recommendations included: reducing human caused mortality, implementing population augmentation in the Cabinet Mountains, enhancing population interchange by improving internal and external population linkage, and motorized access management on public lands to reduce mortality risk and habitat displacement. Recovery efforts have and will continue to emphasize these recommendations.

OBJECTIVES

A. Cabinet Mountains Population Augmentation:

Test grizzly bear augmentation techniques in the Cabinet Mountains to determine if transplanted bears will remain in the area of release and ultimately contribute to the population through reproduction.

B. Recovery Zone Research and Monitoring:

1. Document grizzly bear distribution in the CYE.
2. Describe and monitor the grizzly bear population in terms of reproductive success, age structure, mortality causes, population trend, and population estimates and report this

information through the grizzly bear recovery plan monitoring process.

3. Determine habitat use and movement patterns of grizzly bears. Determine habitat preference by season and assess the relationship between human-altered habitats such as logged areas and grizzly bear habitat use. Evaluate grizzly bear movement permeability of the Kootenai River valley between the Cabinet Mountains and the Yaak River drainage and across the Moyie River Valley in British Columbia.
4. Determine the relationship between human activity and grizzly bear habitat use through the identification of areas used more or less than expected in relation to ongoing timber management activities, open and closed roads, and human residences.
5. Identify mortality sources and management techniques to limit human-caused mortality of grizzly bears.
6. Conduct black bear studies incidental to grizzly bear investigations to determine interspecific relations. Data on black bear densities, reproduction, mortality, movements, habitat-use, and food habits relative to grizzly bears will be gathered and analyzed.

STUDY AREA

The CYE (48° N, 116° W) encompasses approximately 6,800 km^2 of northwest Montana and northern Idaho (Fig. 2). The Cabinet Mountains constitute about 58% of the CYE and lie south of the Kootenai River. The Yaak River portion borders Canadian grizzly populations to the north. There are two potential linkage areas between the Yaak and the Cabinets – one between Libby and Troy and one between Troy and the Idaho border. Prior to 2012 we were unable to document any grizzly bear movement between these areas or grizzly bear use within these linkage zones; however, since that time we have documented several instances of male bears moving from the Selkirk Mountains or the Yaak River into the Cabinet Mountains. Approximately 90% of the recovery area is on public land administered by the Kootenai, Lolo, and Panhandle National Forests. Plum Creek Timber Company Inc. and Stimson Corp. are the main corporations holding a significant amount of land in the area. Individual ownership exists primarily along major rivers, and there are numerous patented mining claims along the Cabinet Mountains Wilderness boundary. The Cabinet Mountains

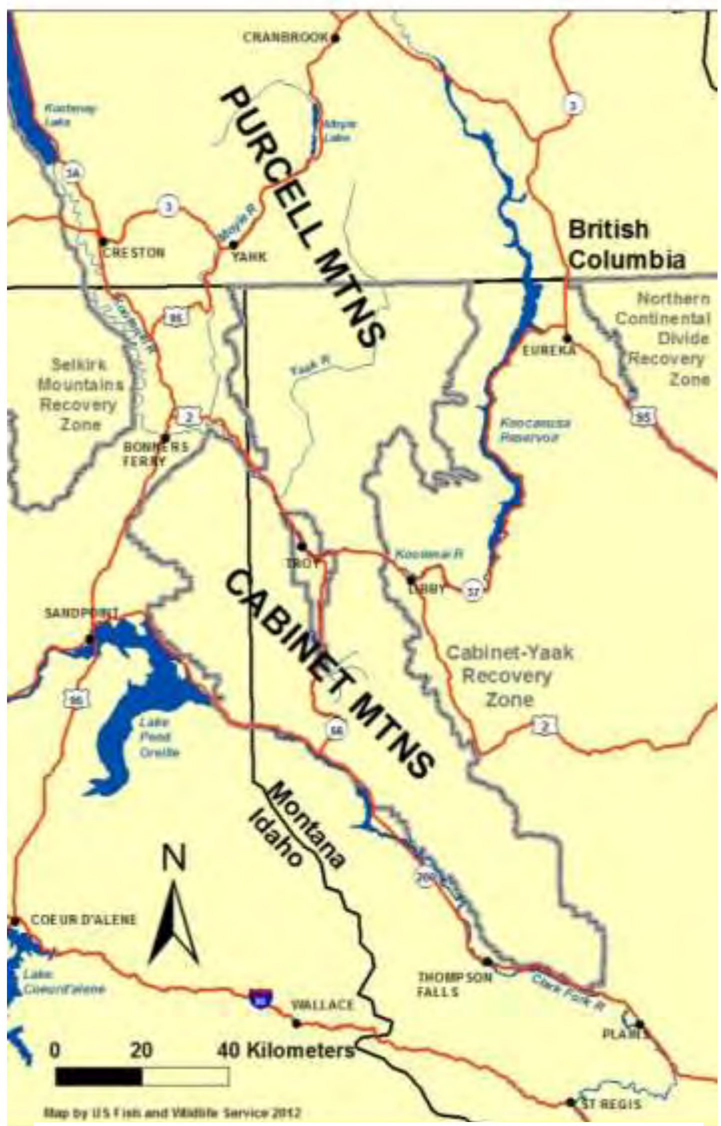

Figure 2. Cabinet-Yaak grizzly bear recovery zone.

Wilderness encompasses 381 km^2 of higher elevations of the study area in the Cabinet Mountains. Bonners Ferry, Libby, Noxon, Sandpoint, Troy, Thompson Falls, and Trout Creek are the primary communities adjacent to the Cabinet Mountains.

Elevations in the Cabinet Mountains range from 610 m along the Kootenai River to 2,664 m at Snowshoe Peak. The area has a Pacific maritime climate characterized by short, warm summers and heavy, wet winter snowfalls. Lower, drier slopes support stands of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*), whereas grand fir (*Abies grandis*), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) dominate lower elevation moist sites. Subalpine fir (*Abies lasiocarpa*), spruce (*Picea spp.*), and mountain hemlock (*Tsuga mertensiana*) dominate stands between 1,500 m and timberline. Mixed coniferous and deciduous tree stands are interspersed with riparian shrub fields and wet meadows along major drainages. Huckleberry (*Vaccinium spp.*) and mixed shrub fields are partially a result of wildfires that occurred in 1910 and 1929 and more recent stand replacing fires. Fire suppression has reduced wildfires as a natural force creating or maintaining berry-producing shrub fields.

The Yaak River drainage lies in the extreme northwestern corner of Montana, northeastern Idaho, and southern British Columbia and is bounded on the east and south by Lake Koocanusa and the Kootenai River, to the west by the Moyie River, and to the north by the international boundary. Two north-south trending mountain ranges dominate the landscape - the McGillivray range in the east and the Purcell range to the west. Topography is varied, with rugged, alpine glaciated peaks present in the Northwest Peaks Scenic Area. Rounded peaks and ridges cover most of the remaining area, a result of continental glaciation. Coniferous forests dominate, with cutting units the primary source of diversity. Much of the Yaak River is low gradient and the river tends to meander, creating lush riparian zones and meadows. Elevations range from 550 m at the confluence of the Kootenai and Moyie Rivers to 2348 m atop Northwest Peak. Vegetation is diverse, with an overstory of western hemlock and western red cedar the indicated climax species on much of the study area. Ponderosa pine and Douglas-fir are common at lower elevations on south and west slopes. Subalpine fir and spruce dominate the upper elevations and cirque basins. Large stands of lodgepole pine and western larch (*Larix occidentalis*) occur at mid and upper elevations and are largely the result of extensive wildfires in the past. In recent decades, several stand altering fires have occurred in the Yaak River. Additionally, the Kootenai and Idaho Panhandle National Forests have implemented prescribed fire to promote grizzly bear habitat in recent years.

Understory and non-forested habitats include graminoid parks consisting primarily of fescue (*Festuca* spp.) and bluebunch wheatgrass (*Agropyron spicatum*), which occur at moderate to high elevations. Riparian shrub fields of red-osier dogwood (*Cornus stolonifera*) and hawthorn (*Crataegus douglasii*) are prevalent along major drainages. Buffaloberry (*Shepherdia canadensis*) is common under stands of open lodgepole pine while serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) prevail on drier, rockier sites. Huckleberry shrub fields are often found under open timber canopies adjacent to graminoid parks, in old burns, in cutting units, and intermixed with beargrass (*Xerophyllum tenax*). Recent wildfires at upper elevations have had more influence on habitat in the CYE. An outbreak of pine bark beetles resulted in logging large areas at lower elevations during the 1980's. Large portions of upper elevations had been logged earlier in response to a spruce bark beetle (*Dendroctonus obesus*) epidemic.

During 1990–1994, Cabinet Mountains population augmentation trapping was conducted in the upper North Fork of the Flathead River drainage and the Wigwam River drainage in southeast British Columbia, approximately 10–40 km north of the U.S. border. Trapping was also conducted south of the international border in the North Fork of the Flathead River in 1992. Since 2005, augmentation trapping has occurred south of the international border in the Flathead River drainage.

METHODS

This annual report is cumulative and represents almost all data collected since the inception of this monitoring program since 1983. New information collected or made available to this study was incorporated into summaries and may change previous results.

Grizzly Bear Observations and Mortality

All grizzly bear observations and reports of sign (tracks, digs, etc.) by study personnel and the public were recorded. Grizzly bear sighting forms were sent to a variety of field personnel from different agencies to maximize the number of reports received. Sightings of grizzly bears were rated 1–5 with 5 being the best quality and 1 being the poorest. General definitions of categories are presented below, but it was difficult to describe all circumstances under which sightings were reported. Only sightings receiving ratings of 4 or 5 were judged credible for use in reports. Sightings that rate 1 or 2 may not be recorded in the database.

5 - Highest quality reports typically from study personnel or highly qualified observers. Sightings not obtained by highly qualified observers must have physical evidence such as pictures, track measurements, hair, or sightings of marked bears where marks are accurately described.

4 - Good quality reports that provide credible, convincing descriptions of grizzly bears or their sign. Typically, these reports include a physical description of the animal mentioning several characteristics. Observer had sufficient time and was close enough or had binoculars to aid identification. Observer demonstrates sufficient knowledge of characteristics to be regarded as a credible observer. Background or experience of observer may influence credibility.

3 - Moderate quality reports that do not provide convincing descriptions of grizzly bears. Reports may mention one or two characteristics, but the observer does not demonstrate sufficient knowledge of characteristics to make a reliable identification. Observer may have gotten a quick glimpse of the bear or been too far away for a good quality observation.

2 - Lower quality observations that provide little description of the bear other than the observer's judgment that it was a grizzly bear.

1 - Lowest quality observations of animals that may not have been grizzly bears. This category may also involve secondhand reports from someone other than the observer.

Reported grizzly bear mortality includes all bears known to have died within the U.S. and within 16 km of the international border in Canada. Many bears collared in the U.S. have home ranges that extend into Canada. Mortality occurring in this area within Canada can affect calculations for U.S. populations. All radio collared bear mortality was reported regardless of location in the U.S. or Canada.

Survival and Mortality Calculations

Survival rates for all age classes except cubs were calculated by use of the Kaplan-Meier procedure as modified for staggered entry of animals (Pollock *et al*. 1989, Wakkinen and Kasworm 2004). Assumptions of this method include: marked individuals were representative of the population, individuals had independent probabilities of survival, capture and radio collaring did not affect future survival, censoring mechanisms were random, a time origin could be defined, and newly collared animals had the same survival function as previously collared animals. Censoring was defined as radio-collared animals lost due to radio failure, radio loss, or emigration of the animal from the study area. Kaplan-Meier estimates may differ slightly from

Booter survival estimates used in the trend calculation. Survival rates were calculated separately for native, augmentation, and management bears because of biases associated with the unknown proportion of management bears in the population and known differences in survival functions.

Our time origin for each bear began at capture. If a bear changed age classification while radio-collared (i.e., subadult to adult), the change occurred on the first of February (the assigned birth date of all bears). Weekly intervals were used in the Kaplan-Meier procedure during which survival rates were assumed constant. No mortality was observed during the denning season. Animals were intermittently added to the sample over the study. Mortality dates were established based on radio telemetry, collar retrieval, and mortality site inspection. Radio failure dates were estimated using the last radiolocation date when the animal was alive.

Cub recruitment rates to 1 year of age were estimated as: {1 - (cub mortalities / total cubs observed)}, based on observations of radio-collared females (Hovey and McLellan 1996). Mortality was assumed when a cub disappeared or if the mother died. Cubs were defined as bears < 1.0-year-old.

Use of known human-caused mortality counts probably results in under-estimates of total human-caused mortality. Numerous mortalities were reported only because animals wore a radio-collar at the time of death. The public reporting rate of bears wearing radio-collars can be used to develop a correction factor to estimate unreported mortality (Cherry *et al*. 2002). The correction factor was not applied to natural mortality, management removals, mortality of radio-collared bears, or bears that died of unknown causes. All radioed bears used to develop the unreported mortality correction were >2 years-old and died from human related causes.

Cabinet Mountains augmentation individuals were counted as mortalities when removed from the Northern Continental Divide Ecosystem and are not counted again as mortalities in the CYE if they die during their first year (Appendix Table T2). Mortalities in Canada are not counted toward recovery goals (USFWS 1993) even though bears initially marked within the CYE have died in Canada. Bears originating in Canada that die in the US are counted.

Reproduction

Reproduction data was gathered through observations of radio-collared females with offspring and genetics data analyzed for maternity relationships. Because of possible undocumented neonatal loss of cubs, no determination of litter size was made if an observation was made in late summer or fall. Inter-birth interval was defined as length of time between subsequent births. Age of first parturition was determined by presence or lack of cubs from observations of aged radio-collared bears and maternity relationships in genetics data from known age individuals.

Population Growth Rate

We used the software program Booter 1.0 (© F. Hovey, Simon Fraser University, Burnaby, B.C.) to estimate the finite rate of increase (λ, or lambda) for the study area's grizzly bear populations. The estimate of λ was based on adult and subadult female survival, yearling and cub survival, age at first parturition, reproductive rate, and maximum age of reproduction.

Booter uses the following revised Lotka equation (Hovey and McLellan 1996), which assumes a stable age distribution:

(1) $0 = \lambda^{a} - S_{a}\,\lambda^{a-1} - S_{c}S_{y}S_{s}^{a-2}\,m[1 - (S_{a} / \lambda)^{w-a+1}]$,

where S_a, S_s, S_y, and S_c are adult female, subadult female, yearling, and cub survival rates, respectively, a = age of first parturition, m = rate of reproduction, and w = maximum age. Booter calculates annual survival rates with a seasonal hazard function estimated from

censored telemetry collected through all years of monitoring in calculation of λ. This technique was used on adults, subadults, and yearlings. Point estimates and confidence intervals may be slightly different from those produced by Kaplan-Meier techniques (differences in Tables 14 and 15). Survival rate for each class was calculated as:

(2) $$S_i = \prod_{j=1}^{k} e^{-L_j(D_{ij} - T_{ij})}$$

where S_i is survival of age class i, k is the number of seasons, D_{ij} is the number of recorded deaths for age class i in season j, T_{ij} is the number of days observed by radio telemetry, and L_j is the length of season j in days. Cub survival rates were estimated by 1 - (cub mortalities / total cubs born), based on observations of radio-collared females. Intervals were based on the following season definitions: spring (1 April - 31 May), summer (1 June - 31 August), autumn (1 September - 30 November), and winter (1 December - 31 March). Intervals were defined by seasons when survival rates were assumed constant and corresponded with traditional spring and autumn hunting seasons and the denning season.

Booter provides several options to calculate a reproductive rate (m) and we selected three to provide a range of variation (McLellan 1989). The default calculation requires a reproductive rate for each bear based upon the number of cubs produced divided by the number of years monitored. We input this number for each adult female for which we had at least one litter size and at least three successive years of radio monitoring, captures, or observations to determine reproductive data. We ran the model with this data and produced a trend calculation. Among other options, Booter allows use of paired or unpaired litter size and birth interval data with sample size restricted to the number of females. If paired data is selected, only those bears with both a known litter size and associated inter-birth interval are used. The unpaired option allows the use of bears from which accurate counts of cubs were not obtained but interval was known, for instances where litter size was known but radio failure or death limited knowledge of intervals. To calculate reproductive rates under both these options, the following formula was used (from Booter 1.0):

(3) $$m = \frac{\displaystyle\sum_{i=1}^{n} \frac{\sum_{j=1}^{p} L_{ij}}{\sum_{j=1}^{k} B_{IJ}}}{n}$$

where n = number of females; j = observations of litter size (L) or inter-birth interval (B) for female i; p = number of observations of L for female i; and k = number of observations of B for female i. Note k and p may or may not be equal. Cub sex ratio was assumed to be 50:50 and maximum age of female reproduction (w) was set at 27 years (Schwartz *et al*. 2003). Average annual exponential rate of increase was calculated as $r = \log_e \lambda$ (Caughley 1977).

Bears captured and relocated to the Cabinet Mountains as part of population augmentation were not included in the population trend calculation (Appendix Table T1). None of these animals had any prior history of nuisance activity. Bears captured initially as objects of

conflict captures were not included. Several native bears that were captured as part of a preemptive move to avoid nuisance activity were included. Currently collared bears that became management bears while wearing a collar were included.

Capture and Marking

Capture and handling of bears followed an approved Animal Use Protocol through the University of Montana, Missoula, MT (061-14CSCFC111714 and 040-20HCCFC-092420). Capture of black bears and grizzly bears was performed under state permits 2020-066-W and federal permit TE704930-2. Bears were captured with leg-hold snares following the techniques described by Johnson and Pelton (1980) and Jonkel (1993). Snares were manufactured in house following the Aldrich Snare Co. (Clallam Bay, WA) design and consist of 6.5 mm braided steel aircraft cable. Bears were immobilized with either Telazol (tiletamine hydrochloride and zolazepam hydrochloride), a mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine hydrochloride), a mixture of Telazol and Dexmedetomidine, or a combination of Telazol and Rompun. Yohimbine and Atipamezole were the primary antagonists for Rompun and Dexmedetomidine. Drugs were administered intramuscularly with a syringe mounted on a pole (jab-stick), homemade blowgun, modified air pistol, or cartridge powered dart gun. Immobilized bears were measured, weighed, and a first premolar tooth was extracted for age determination (Stoneberg and Jonkel 1966). Blood, tissue and/or hair samples were taken from most bears for genetic and food use studies. Immobilized bears were given oxygen at a rate of 2–3 liters per minute. Recovering bears were dosed with Atropine and Diazepam.

All grizzly bears (including management bears captured at conflict sites) and some adult black bears (≥ 4.0 years old) were fitted with radio collars or ear tag transmitters when captured. Some bears were collared with Global Positioning System (GPS) radio collars. Collars were manufactured by Telonics® (Mesa, AZ) and ear tag transmitters were manufactured by Advanced Telemetry Systems® (Isanti, MN). To prevent permanent attachment, a canvas spacer was placed in the collars so that they would drop off in 1–3 years (Hellgren *et al*. 1988).

Trapping efforts were typically conducted from May through September. In 1986–1987, snares were placed in areas where black bear captures were maximized on a defined study area of 214 km^2 (Thier 1990). Snares were placed over a broader area during 1989–1994 to maximize grizzly bear captures. Trap sites were usually located within 200 m of an open road to allow vehicle access. Beginning in 1995, an effort was made to capture and re-collar known grizzly bears in the Yaak River and augmentation bears in the Cabinet Mountains. In 2003, trapping was initiated in the Salish Mountains south of Eureka, Montana to investigate bear movements in the intervening area between the Northern Continental Divide and CYE recovery zones. Trapping was conducted along Highway 2 in northwest Montana and along Highway 3 in southeast British Columbia to collar bears with GPS radio collars during 2004–2010. During 2011, trapping was initiated along Highway 95 near McArthur Lake in northern Idaho and along Interstate 90 near Lookout Pass in Montana and Idaho. All four studies were designed to examine bear population connectivity across river valleys with highways and human habitation. Highway 2, 95, and I-90 studies utilized black bears as surrogates for grizzly bears because of the small number of grizzly bears in the valley. The Highway 3 effort in British Columbia collared grizzly bears and black bears. Much of the trapping effort in the Yaak and Cabinet Mountains areas involved the use of horses on backcountry trails and closed logging roads. Traps were checked daily. Bait consisted primarily of road-killed ungulates.

Trapping for population augmentation was conducted in the North Fork of the Flathead River in British Columbia during 1990–1994. Only female grizzly bears < 6 years old (or prior to first reproduction) and > 35 kg were deemed suitable for transplant. Other captured grizzly bears were released with collaring to aid an ongoing BC bear study. Capture efforts for bears transplanted in 2005–2020 occurred primarily in the North Fork and South Fork of the Flathead River in the US by MFWP. No suitable bears were captured in 1991, 2007, 2017, or 2020.

Hair Sampling for DNA Analysis

This project originally sought evidence of grizzly bears in the Cabinet Mountains using DNA to understand the fates of four bears transplanted during 1990–1994. The program used genetic information from hair-snagging with remote-camera photo verification to identify transplanted bears or their offspring living in the Cabinet Mountains. Since then, sampling has expanded into the Yaak drainage and project objectives now include: observations of females with young, sex ratio of captured bears, relatedness as well as genetic diversity measures of captured bears, and evidence of interpopulation movements of individuals.

Sampling occurred from May–October of 2002–2020 in the CYE in Idaho and Montana following standard hair snagging techniques (Woods *et al.* 1999). Sampling sites were established based on location of previous sightings, sign, and radio telemetry from bears in the CYE. A 5 km x 5 km grid (25 km^2) was used to distribute sample sites across the Cabinet Mountains in 2003 (n =184). Each grid cell contained a single sample point near the center of the cell. Actual site location was modified on the basis of access to the site and habitat quality near the site. Sites were baited with 2 liters of a blood and fish mixture to attract bears across a barbwire perimeter placed to snag hair. Sites were deployed for 2 weeks prior to hair collection. One third of sites were sampled during each of the months of June, July, and August. Sample sites were stratified by elevation with lowest elevation sites sampled in June and highest elevation sites sampled in August. Trail cameras were used at some sites. Hair was collected and labeled to indicate: number and color of hairs, site location, date, and barb number. These data aided sorting hair to minimize lab costs. Solid black hairs were judged to be from black bears and not analyzed further. Samples collected as a part of this effort and other hair samples collected in previous years either from known grizzly bears or samples that outwardly appeared to be grizzly bear were sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Hairs visually identified as black bear hair by technicians at the Laboratory were not processed and hairs processed and determined to be black bear were not genotyped. Dr. Michael Proctor (Birchdale Ecological) is a cooperator on this project and assisted with genetic interpretations. He has previously analyzed genetic samples from the Yaak portion of this recovery zone (Proctor 2003). Hair snag sampling effort during 2012 was altered and reduced to avoid conflicts with a US Geological Survey (USGS) study to estimate CYE grizzly bear population size (Kendall *et al*. 2015). USGS was concerned that our sample sites might influence capture success at their sites.

The USGS study established and sampled 1,373 rub trees across the CYE during 2012. The study made preliminary data available regarding the success of this effort by providing us coordinates of all trees and those trees that produced grizzly bear samples. Sites that produced grizzly bear hair and adjacent sites that were easily sampled in conjunction with successful sites were resampled 2–4 times during 2013–2020. Collected hairs were evaluated by study personnel and samples not judged to be probable black bear were sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping.

Movements of radio collared bears, multiple locations of genetically marked bears, and maternity/paternity analysis were typically used to identify migrants between various bear populations. In the absence of this type of data, we used methods as applied in Proctor *et al*. (2005) and further used in Proctor *et al*. (2012) where program GeneClass uses an algorithm to assign a probability of being a migrant by translating log ratio of assignment to each population into probabilities with thresholds using realistic Type I error rates (Piry et al. 2004, Paetkau et al. 2004). The use of TYPE I error rate in this algorithm is important as it allows researchers to differentiate true migrants from those who might appear as migrants by chance. A bear is determined to be a migrant when it has a very high probability of being born in a population other than the one it was captured in, but also when it is beyond the number of 'putative migrants' who cross assign by chance (the TYPE I error rate). For more detailed treatment of this process see Proctor *et al*. (2005).

We used bears that were DNA sampled prior to 2006, after which population interchange increased and reduced precision in determining population of origin. More specifically, we used a sample of bears from each population: the South Selkirk (n = 49), Yahk (*n* = 33, south of Highway 3) and South Purcells (*n* = 23, north of BC Highway 3) where we were certain of their origin. This contained 2 sets of bears,

- those captured prior to 2005 as this is when we determined inter-population exchange started to increase (Proctor *et al*. 2018) and
- those whose population of origin was known because the offspring were in a perfectly matched triad: mother – father – offspring where the offspring shared an allele at each of 21 loci with each parent and the parents were captured prior to 2005.

Then we added individual bear suspected of being migrants into the analysis dataset, to assess what their probability of origin was, relative to bears of known origin. Migrants we determined to be real had the highest log ratios, of all 'putative' migrants and they were beyond the number of expected 'chance migrants' (the TYPE I error rate). For example, using an alpha value of 0.01 means that 1 in 100 of samples would appear as a migrant by chance alone, and thus would not be real. So, if our analysis identified 4 migrants in a sample of 100 bears, we could then conclude that 3 were likely real migrants as 1 was a migrant by chance (the TYPE I error rate). We would then take the 3 putative migrants with the greatest log ratio and probability of being a migrant and call them real migrants. In practice, the log ratios of these real migrants typically reflect probabilities that are 100–10000 times higher probabilities being a migrant than a resident.

Radio Monitoring

Attempts were made to obtain aerial radiolocations on all instrumented grizzly bears at least once each week during the 7–8 month period in which they were active. GPS collars attempted a location fix every 1–2 hours. Collar releases were programmed to drop in early October for retrieval. Expected collar life varied from 1–3 field seasons over the course of the study depending upon model of collar and programming. Augmentation bears were monitored daily following release for at least the first two weeks and usually three times per week following. In addition, efforts were made to obtain as many ground locations as possible on all bears, usually by triangulating from a vehicle. Life home ranges (minimum convex polygons; Hayne 1959) were calculated for grizzly bears during the study period. We generated home range polygons using ArcMap 10.

Grizzly and black bears were collared with GPS collars during 2004–2010 to study movements across the Moyie River Valley and Highway 3 in British Columbia. Black bears were tested for their potential to act as surrogates that would predict grizzly bear movements. Collars attempted locations every 1–2 hours depending on configuration and data were stored within the collar. Weekly aircraft radio monitoring was conducted to check for mortality signals and approximate location. From 2004 to 2007, black bears were fitted with similar GPS radio collars to study movements across the Kootenai River Valley and Highway 2 in Montana, as part of linkage monitoring between the Yaak River and Cabinet Mountains. In 2008–2012, black bears were fitted with GPS collars in the Yaak River study area and along the Clark Fork River on the south end of the Cabinet Mountains study area.

Scat analysis

Bear scats were collected, tagged, and either dried or frozen. We only considered scats associated with definite grizzly bear sign (tracks, hair, and radio location of instrumented bear) as from grizzly bears. Food habits analysis was completed by William Callaghan (Florence, MT) and Kevin Frey (Bozeman, MT). Samples were rinsed with hot and cold water over 2 different size mesh screens (0.40 and 0.24 cm). The retained contents were identified to

species with the aid of microscopes. We recorded plant part and visually estimated percent volume. We corrected scat volumes with correction factors that incorporate different digestibilities of various food items (Hewitt and Robbins 1996).

Isotope analysis

Hair samples from known age, captured grizzly bears were collected and analyzed for stable isotopic ratios. Stable isotope signatures indicate source of assimilated (i.e., digested) diet of grizzly bears. Nitrogen stable isotope ratios (^{15}N) indicate trophic level of the animal; an increased amount of ingested animal matter yields higher nitrogen isotope ratios while lower values tie to more plant-based diets. In our ecosystem, carbon isotope signatures vary depending on the amount of native C3 vs. C4 plant matter ingested. Corn, a C4 plant, has elevated $^{13}C/^{12}C$ ratios relative to native C3 plants. Because much of the human food stream is composed of corn, carbon stable isotope signatures allow for verification or identification of human food conditioned bears.

Hair samples were rinsed with a 2:1 chloroform:methanol solution to remove surface contaminants. Samples were then ground in a ball mill to homogenize the sample. Powdered hair was then weighed and sealed in tin boats. Isotope ratios of $\delta^{13}C$ and $\delta^{15}N$ were assessed by continuous flow methods using an elemental analyzer (ECS 4010, Costech Analytical, Valencia, California) and a mass spectrometer (Delta PlusXP, Thermofinnigan, Bremen, Germany) (Brenna *et al*. 1997, Qi *et al*. 2003).

Berry Production

Quantitative comparisons of annual fluctuations and site-specific influences on fruit production of huckleberry and buffaloberry were made using methods similar to those established in Glacier National Park (Kendall 1986). Transect line origins were marked by a painted tree or by surveyors' ribbon. A specific azimuth was followed from the origin through homogenous habitat. At 0.5 m intervals, a 0.04 m^2 frame (2 x 2 decimeter) was placed on the ground or held over shrubs and all fruits and pedicels within the perimeter of the frame were counted. If no portion of a plant was intercepted, the frame was advanced at 0.5 m intervals and empty frames were counted. Fifty frames containing the desired species were counted on each transect. Timbered shrub fields and mixed shrub cutting units were the primary sampling areas to examine the influence of timber harvesting on berry production within a variety of aspects and elevations. Notes on berry phenology, berry size, and plant condition were recorded. Service berry, mountain ash, and buffaloberry production was estimated from 10 marked plants at several sites scattered across the recovery area. Since 1989 several sites have been added or relocated to achieve goals for geographic distribution. Some transects were eliminated because plant succession or fire had affected production. Monitoring goals identified an annual trend of berry production and did not include documenting the effects of succession.

Huckleberry sampling began in 1989 at 11 transect sites. Fifteen sites were sampled in 2020. Buffaloberry sampling began in 1990 at 5 sites. Due to the dioecious (separate male and female plants) nature of buffaloberry all frame count transects were dropped in 2007 in favor of marking 10 plants per site and counting the berries on marked plants. Two sites were sampled in 2020. Serviceberry productivity was estimated by counting berries on 10 marked plants at 5 sample sites beginning in 1990. Five sites were sampled in 2020. In 2001, three new plots were established to document berry production of mountain ash (*Sorbus scopulina*). Ten plants were permanently marked at each site for berry counts, similar to the serviceberry plots. Production counts occurred at 3 sites in 2020.

Temperature and relative humidity data recorders (LogTag®, Auckland, New Zealand) were placed at sites beginning in 2011. These devices record conditions at 90 minute intervals and will be retrieved, downloaded, and replaced at annual intervals. We used a berries/plot or berries/plant calculation as an index of berry productivity. Transects were treated as the

independent observation unit. For each year observed, mean numbers of berries/plant (berries/plot) were used as our transect productivity indices. For each year, we indicate whether berry productivity is above average (annual 95% confidence interval falls above study-wide mean), average (confidence interval encompasses the study-wide mean), or below average (confidence interval falls below study-wide mean).

Body Condition

Field measurements and bioelectric impedance analysis (BIA) of captured bears allows us to estimate body condition of grizzly bears in the Cabinet-Yaak (Farley and Robbins 1994). More specifically, these methods allow for estimation of body fat content, an important indicator of quality of food resources and a predictor of cub production for adult females. We attempted estimation on captured bears, characterized by sex-age class, reproductive status, area of capture, and management status. ANOVA and post-hoc Tukey-HSD tests were performed to test for differences in body fat content across factors (management status, sex, and month of capture). Body condition (primarily, body fat content) of reproductive-aged females offers an *indirect* metric of whether females were of a physiological condition that supports cub production (Robbins et al. 2012).

RESULTS AND DISCUSSION

Research and monitoring with telemetry and full-time personnel were present since 1983 and therefore this date represents the most intense period of data collection. All tables and calculations are updated when new information becomes available. For instance, genetic analysis determined the sex of a previously unknown mortality (2012) and a bear originally identified as a probable mortality (2003) was removed when genetic evidence later indicated that the bear survived that incident. Covid-19 protocols reduced the monitoring effort substantially during 2020.

Grizzly Bear Observations and Recovery Plan Targets

Grizzly bear observations and mortality from public and agency sightings or records were appended to databases. These databases include information from the U.S. and Canada. The file includes over 1,900 credible sightings, tracks, scats, digs, hair, and trail camera photographs dating from 1960 (Fig. 3) and over 135 mortalities dating from 1949 (Table 1, Appendix Table 2, Fig. 3). Credible sightings were those rating 4 or 5 on the 5-point scale (see page 9). Sixty-three instances of grizzly bear mortality were detected inside or within 16 km of the CYE during 1982–2020 (Table 1). Sixty-three credible sightings were reported to this study that rated 4 or 5 (most credible) during 2020. Forty-five of these sightings occurred in the Yaak portion of the CYE and 18 sightings occurred in the Cabinet Mountains portion of the CYE (Table 2 and Fig. 3). Sightings of females with young or mortalities that occur outside the recovery zone are counted in the closest BMU. Two grizzly bear cubs believed dead in 2018 when their mother was killed were found to be alive in 2019 and were removed from the mortality list.

<u>Recovery Target 1: 6 females with cubs over a running 6-year average both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone</u>.
Fourteen credible sightings of a female with cubs occurred during 2020 in Bear Management Units (BMUs) 5, 6, 11, 12, 13, 14, and 15 (Tables 2, 3, 4, 5, Fig. 4 and 5). There appeared to be 5 unduplicated females with cubs in the recovery area or within 10 miles during 2020. Thirteen credible sightings of a female with yearlings or 2-year-olds occurred in BMU 6, 11, 13, 14, 15, 16, 17, and 18. Unduplicated sightings of females with cubs (excluding Canada) varied

from 2–5 per year and averaged 3.3 per year from 2015–2020 (Tables 3, 4). This target has not been met.

Recovery Target 2: 18 of 22 BMU's occupied by females with young from a running 6-year sum of verified evidence.

Thirteen of 22 BMUs in the recovery zone had sightings of females with young (cubs, yearlings, or 2-year-olds) during 2015–2020 (Figs. 4, 5, Table 6). Occupied BMUs were: 2, 4, 5, 6, 8, 11, 12, 13, 14, 15, 16, 17, and 18. This target has not been met.

Recovery Target 3: The running 6-year average of known, human-caused mortality should not exceed 4 percent of the population estimate based on the most recent 3-year sum of females with cubs. No more than 30 percent shall be females. These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved.

Two known or probable human caused mortalities occurred during 2020. A subadult male was killed by a black bear hunter through mistaken identity. The bear had a neck snare around it's neck that may have ultimately killed the bear had it not been shot. The second bear was an adult female that is under investigation by enforcement authorities. Two grizzly bear cubs believed dead in 2018 when their mother was killed were found to be alive in 2019 and were removed from the mortality list. Nine known or probable human caused mortalities of grizzly bears have occurred in or within 10 miles of the CYE in the U.S. during 2015–2020 (Table 1), including 3 females (BMUs 5, 11, 14) and 6 males (BMUs 2, 12, 13, 17, and 19). These mortalities included three adult females (two under investigation and a self-defense), one adult male (management) and five subadult males (self-defense, poaching, mistaken identity, and two human caused under investigation). We estimated minimum population size by dividing observed females with cubs during 2018–2020 (12) minus any human-caused adult female mortality (3) by 0.6 (sightability correction factor as specified in the recovery plan) then divide the resulting dividend by 0.284 (adult female proportion of population, as specified in the recovery plan) (Tables 3, 4) (USFWS 1993). This resulted in a minimum population of 53 individuals. The recovery plan stated; "any attempt to use this parameter to indicate trends or precise population size would be an invalid use of these data". Applying the 4% mortality limit to the minimum calculated population resulted in a total mortality limit of 2.1 bears per year. The female limit is 0.6 females per year (30% of 2.1). Average annual human caused mortality for 2015–2020 was 1.5 bears/year and 0.5 females/year. The mortality levels for total bears and females were less than the calculated limit during 2015–2020. The recovery plan established a goal of zero human-caused mortality for this recovery zone due to the initial low number of bears, however it also stated "In reality, this goal may not be realized because human bear conflicts are likely to occur at some level within the ecosystem." Therefore, even if the goal of zero mortality is not met, it is important to evaluate the targets to determine if we are making progress towards recovery. During the 2015–2020 reporting period, total and female mortality met the target. All tables and calculations were updated as new information becomes available.

Table 1. Known and probable grizzly bear mortality in or within 16 km of the Cabinet-Yaak grizzly bear recovery zone (including Canada). Includes all radio collared bears regardless of location, 1982–2020.

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
October, 1982	None	M	AD	Human, Poaching	Grouse Creek, ID	No	Yes	USFS
October, 1984	None	Unk	Unk	Human, Mistaken Identity, Black bear	Harvey Creek, ID	Yes	Yes	USFS
9/21/1985	14	M	AD	Human, Self Defense	Lyons Gulch, MT	No	Yes	USFS
7/14/1986	106 cub	Unk	Cub	Natural	Burnt Creek, MT	Unk	No	USFS
10/25/1987	None	F	Cub	Human, Mistaken Identity, Elk	Flattail Creek, MT	No	Yes	USFS

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
5/29/1988[1]	134	M	AD	Human, Legal Hunter kill	Moyie River, BC	Yes	Yes	BC
10/31/1988	None	F	AD	Human, Self Defense	Seventeen Mile Creek, MT	No	Yes	USFS
7/6/1989	129	F	3	Human, Research	Burnt Creek, MT	Yes	No	USFS
1990	192	M	2	Human, Poaching	Poverty Creek, MT	Yes	Yes	USFS
1992	678	F	37	Unknown	Trail Creek, MT	No	Yes	USFS
7/22/1993	258[2]	F	7	Natural	Libby Creek, MT	No	No	USFS
7/22/1993	258-cub	Unk	Cub	Natural	Libby Creek, MT	No	No	USFS
10/4/1995[1]	None	M	AD	Human, Management	Ryan Creek, BC	Yes	Yes	PRIV
5/6/1996	302	M	3	Human, Undetermined	Dodge Creek, MT	Yes	No	USFS
October, 1996[1]	355	M	AD	Human, Undetermined	Gold Creek, BC	Yes	No	BC
June? 1997	None	M	AD	Human, Poaching	Libby Creek, MT	Unk	Yes	PRIV
6/4/1999	106	F	21	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	M	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	F	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
10/12/1999[1]	596	F	2	Human, Self Defense	Hart Creek, BC	Yes	Yes	BC
11/15/1999	358	M	15	Human, Management	Yaak River, MT	Yes	Yes	PRIV
6/1/2000[1]	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
6/1/2000[1]	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
7/1/2000	303-cub	Unk	Cub	Natural	Fowler Creek, MT	Unk	No	USFS
11/15/2000	592	F	3	Human, Undetermined	Pete Creek MT	Yes	No	USFS
5/5/2001	None	F	1	Human, Mistaken Identity, Black Bear	Spread Creek, MT	Yes	Yes	USFS
6/18/2001[1]	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
6/18/2001[1]	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
9/6/2001	128	M	18	Human, Undetermined	Swamp Creek, MT[3]	Yes	No	PRIV
October, 2001	None	F	AD	Human, Train collision	Elk Creek, MT	Yes	Yes	MRL
6/24/2002[1]	None	Unk	Unk	Human, Mistaken Identity, Hounds	Bloom Creek, BC	Yes	Yes	BC
7/1/2002	577	F	1	Natural	Marten Creek, MT	Yes	No	USFS
10/28/2002	None	F	4	Human, Undetermined	Porcupine Creek, MT	Yes	Yes	USFS
11/18/2002	353/584	F	7	Human, Poaching	Yaak River, MT	Yes	Yes	PRIV
11/18/2002	None	F	Cub	Human, Poaching	Yaak River, MT	Yes	Yes	PRIV
11/18/2002	None	Unk	Cub	Human, Poaching	Yaak River, MT	Yes	No	PRIV
10/15/2004[1]	None	F	AD	Human, Management	Newgate, BC	Yes	Yes	PRIV
2005?	363	M	14	Human, Undetermined	Curley Creek, MT	Yes	Yes	PRIV
10/9/2005	694	F	2	Human, Undetermined	Pipe Creek, MT	Yes	No	PCT
10/9/2005	None	F	2	Human, Train collision	Government Creek, MT	Yes	Yes	MRL
10/19/2005	668	M	3	Human, Mistaken Identity, Black bear	Yaak River, MT	Yes	Yes	PRIV
5/28/2006[1]	None	F	4	Human, Research	Cold Creek, BC	Yes	No	BC
6/1/2006[1]	292	F	5	Human, Management	Moyie River, BC	Yes	Yes	PRIV
9/22/2007	354	F	11	Human, Self Defense	Canuck Creek, MT	Yes	Yes	USFS
9/24/2008	?	M	3	Human, Under Investigation	Fishtrap Creek, MT	Yes	Yes	PCT
10/20/2008[2]	790	F	3	Human, Poaching	Clark Fork River. MT	Yes	Yes	PRIV
10/20/2008[2]	635	F	4	Human, Train collision	Clark Fork River. MT	Yes	Yes	MRL
11/15/2008[1]	651	M	13	Human, Mistaken Identity, Wolf Trap	NF Yahk River, BC	Yes	Yes	BC
6/5/2009	675-cub	Unk	Cub	Natural	Copper Creek, ID	Unk	No	USFS
6/5/2009	675-cub	Unk	Cub	Natural	Copper Creek, ID	Unk	No	USFS
6/7/2009[3]	None	M	3-4	Human, Mistaken Identity, Black bear	Bentley Creek, ID[3]	Yes	Yes	PRIV
11/1/2009	286	F	Adult	Human, Self Defense	EF Bull River, MT	No	Yes	USFS
6/25/2010	675-cub	Unk	Cub	Natural	American Creek, MT	Unk	No	USFS
7/7/2010	303-cub	Unk	Cub	Natural	Bearfite Creek, MT	Unk	No	USFS
9/6/2010[1]	1374	M	2	Human, Under Investigation	Hawkins Creek, BC	Yes	No	BC
9/24/2010[1]	None	M	2	Human, Wolf Trap, Selkirk Relocation	Cold Creek, BC	Yes	Yes	BC
10/11/2010	None	M	AD	Human, Under Investigation	Pine Creek, MT	No	Yes	USFS
2011	None	F	1	Unknown	EF Rock Creek, MT	No	Yes	USFS
9/16/2011	None	M	AD	Human, Mistaken Identity	Faro Creek, MT	No	Yes	USFS
11/13/2011	799	M	4	Human, Mistaken Identity	Cherry Creek, MT	Yes	Yes	USFS
11/24/2011	732	M	3	Human, Defense of life	Pipe Creek, MT	Yes	Yes	PRIV
November 2011	342	M	19	Human, Under Investigation	Little Creek, MT	Yes	Yes	PRIV

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
5/18/2012	None	F	AD	Human, Under Investigation	Mission Creek, ID	Yes	Yes	USFS
5/18/ 2012	None	M	Cub	Human, Under Investigation	Mission Creek, ID	Yes	Yes	USFS
October 2012[1]	5381	M	8	Human, Management	Duck Creek, BC	Yes	Yes	PRIV
10/26/2014	79575279	M	6	Human, Self defense	Little Thompson River, MT	Yes	Yes	PRIV
5/15/2015[1]	552-ygl	Unk	1	Natural	Linklater Creek, BC	Unk	No	BC
5/23/2015[2]	921	F	3	Natural	NF Ross Creek, MT	No	No	USFS
5/24/2015	None	M	4?	Human, Poaching	Yaak River, MT	Yes	Yes	USFS
8/12/2015	818	M	2	Human, Self Defense	Moyie River, ID	Yes	Yes	PRIV
9/30/2015[2]	924	M	2	Human, Mistaken Identity	Beaver Creek, ID[3]	Yes	Yes	PRIV
10/11/2015	1001	M	6	Human, Under Investigation	Grouse Creek, ID	Yes	No	PRIV
9/1/2017[1]	922	M	5	Human, Self defense	Porthill Creek, BC	Yes	Yes	BC
4/16/2018	821	M	4	Unknown probable	Pine Creek, MT	Yes	Yes	PRIV
5/21/2018	9077	M	3	Human, Under Investigation	Bristow Creek, MT	Yes	No	USFS
9/5/2018	810	F	15	Human, Under Investigation	Spruce Creek, ID	Yes	No	USFS
5/24/2019	None	Unk	Cub	Natural	Skin Creek, MT	No	No	USFS
5/24/2019	None	Unk	Cub	Natural	Skin Creek, MT	No	No	USFS
8/2/2019	None	F	Adult	Human, Self Defense	EF Bull River, MT	No	Yes	USFS
11/10/2019	770	M	25	Human, Management	Libby Creek, MT	Yes	Yes	PRIV
5/22/2020[1]	675	F	18	Human, Self Defense	Cold Creek, BC	Yes	Yes	BC
8/31/2020	BC 4-121	M	3	Human, Mistaken Identity	Deer Creek, ID	No	Yes	USFS
11/19/2020	729	F	10	Human, Under Investigation	Clay Creek, MT	Yes	No	PRIV

[1]The recovery plan (USFWS 1993) specifies that human-caused mortality or female with young sightings from Canada will not be counted toward recovery goals in the CYGBRZ. BC – British Columbia, MRL – Montana Rail Link, PRIV – Individual Private, PCT – Plum Creek Timber Company, USFS – U.S. Forest Service.
[2]Bears transplanted to the Cabinet Mountains under the population augmentation program were counted as mortalities in their place of origin and are not counted toward recovery goals in this recovery zone.
[3]Bear Killed more than 10 miles outside recovery zone in the US and not counted in recovery calculations.

Table 2. Credible grizzly bear sightings, credible female with young sightings, and known human caused mortality by bear management unit (BMU) or area, 2020.

BMU OR AREA	2020 Credible Grizzly Bear Sightings	2020 Sightings of Females with Cubs (Total)	2020 Sightings of Females with Cubs (Unduplicated)	2020 Sightings of Females with Yearlings or 2-year-olds (Total)	2020 Sightings of Females with Yearlings or 2 year-olds (unduplicated)	2020 Human Caused Mortality
1	1	0	0	0	0	0
2	2	0	0	0	0	0
3	0	0	0	0	0	0
4	2	1	1	0	0	0
5	7	1	1	3	1	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	1	0	0	0	0	0
10	0	0	0	0	0	0
11	9	1	0	3	0	1
12	9	2	1	0	0	0
13	10	2	1	1	1	1
14	2	1	0	1	0	0
15	2	1	0	1	0	0
16	4	0	0	1	0	0
17	1	0	0	1	1	0
18	0	0	0	1	0	0
19	1	0	0	0	1	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
BC Yahk GBPU	1	0	0	1	0	1
Cabinet Face	2	2	0	0	0	0
Deer Ridge	2	1	0	0	0	0
Fisher	1	0	0	0	0	0
South Clark Fork	0	0	0	0	0	0
Troy	2	0	0	0	0	0
West Kootenai	4	2	1	0	0	0
2020 TOTAL	63	14	5	13	4	3

[1]Credible sightings are those rated 4 or 5 on a 5 point scale (see methods).
[2]Sightings may duplicate the same animal in different locations. Only the first sighting of a duplicated female with cubs is counted toward total females (Table 3), however subsequent sighting contribute toward occupancy (Table 8).
[3]Areas in Canada outside of Cabinet-Yaak recovery zone that do not count toward recovery goals.
[4]Areas with portions <16 km outside the Cabinet-Yaak recovery zone that do not count toward recovery goals.

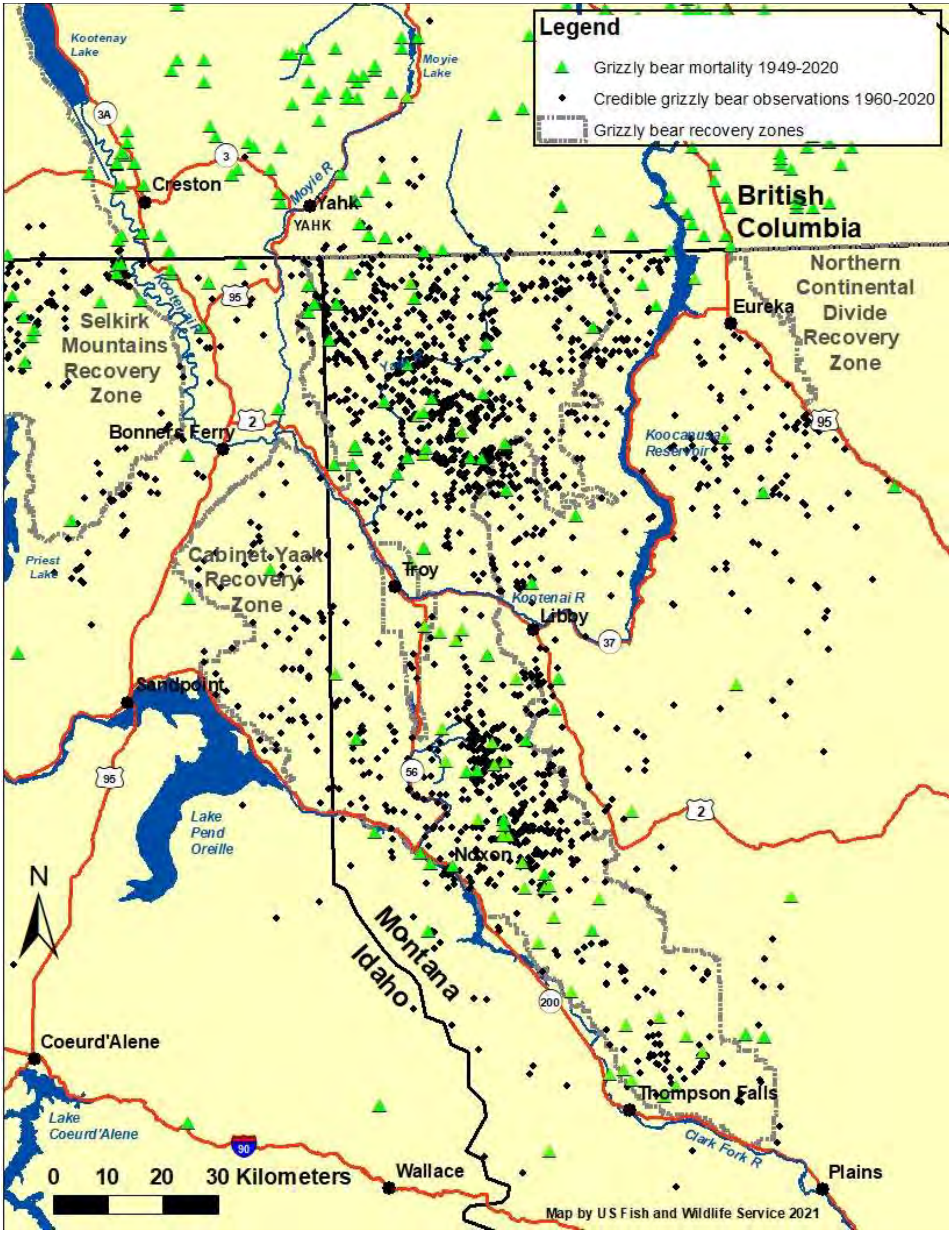

Figure 3. Grizzly bear observations (1959–2020) and known or probable mortalities from all causes (1949–2020) in and around the Cabinet-Yaak recovery area.

Table 3. Status of the Cabinet-Yaak recovery zone during 2015–2020 in relation to the demographic recovery targets from the grizzly bear recovery plan (USFWS 1993).

Recovery Criteria	Target	2015–2020
Females w/cubs (6-yr avg)	6	3.3 (20/6)
Human Caused Mortality limit (4% of minimum estimate)[1]	2.1	1.5 (6 yr avg)
Female Human Caused mortality limit (30% of total mortality)[1]	0.6	0.5 (6 yr avg)
Distribution of females w/young	18 of 22	13 of 22

[1] The grizzly bear recovery plan states "Because of low estimated population and uncertainty in estimates, the current human-caused mortality goal to facilitate recovery of the population is zero. In reality, this goal may not be realized because human bear conflicts are likely to occur at some level within the ecosystem".

Table 4. Annual Cabinet-Yaak recovery zone (excluding Canada) grizzly bear unduplicated counts of females with cubs (FWC's) and known human-caused mortality, 1993–2020.

YEAR	ANNUAL FWC'S	ANNUAL HUMAN CAUSED ADULT FEMALE MORTALITY	ANNUAL HUMAN CAUSED ALL FEMALE MORTALITY	ANNUAL HUMAN CAUSED TOTAL MORTALITY	4% TOTAL HUMAN CAUSED MORTALITY LIMIT[1]	30% ALL FEMALE HUMAN CAUSED MORTALITY LIMIT[1]	TOTAL HUMAN CAUSED MORTALITY 6 YEAR AVERAGE	FEMALE HUMAN CAUSED MORTALITY 6 YEAR AVERAGE
1993	2	0	0	0	0.9	0.3	0.5	0.3
1994	1	0	0	0	0.9	0.3	0.3	0.2
1995	1	0	0	0	0.9	0.3	0.2	0.0
1996	1	0	0	1	0.7	0.2	0.2	0.0
1997	3	0	0	1	1.2	0.4	0.3	0.0
1998	0	0	0	0	0.9	0.3	0.3	0.0
1999	0	0	0	1	0.7	0.2	0.5	0.0
2000	2	0	1	1	0.5	0.1	0.7	0.2
2001	1	1	2	2	0.5	0.1	1.0	0.5
2002	4	1	4	4	1.2	0.4	1.5	1.2
2003	2	0	0	0	1.2	0.4	1.3	1.2
2004	1	0	0	0	1.4	0.4	1.3	1.2
2005	1	0	2	4	0.9	0.3	1.8	1.5
2006	1	0	0	0	0.7	0.2	1.7	1.3
2007	4	1	1	1	1.2	0.4	1.5	1.2
2008	3	0	0	1	1.6	0.5	1.0	0.5
2009	2	1	1	1	1.6	0.5	1.2	0.7
2010	4	0	0	1	1.9	0.6	1.3	0.7
2011	1	0	0	4	1.4	0.4	1.3	0.3
2012	3	1	1	2	1.6	0.5	1.7	0.5
2013	2	0	0	0	1.2	0.4	1.5	0.3
2014	3	0	0	1	1.6	0.5	1.5	0.3
2015	2	0	0	3	1.6	0.5	1.8	0.2
2016	3	0	0	0	1.9	0.6	1.7	0.2
2017	3	0	0	0	1.9	0.6	1.0	0.2
2018	5	1	2	4	2.3	0.7	1.3	0.3
2019	2	1	1	2	1.9	0.6	1.7	0.5
2020	5	1	1	2	2.1	0.6	1.5	0.5

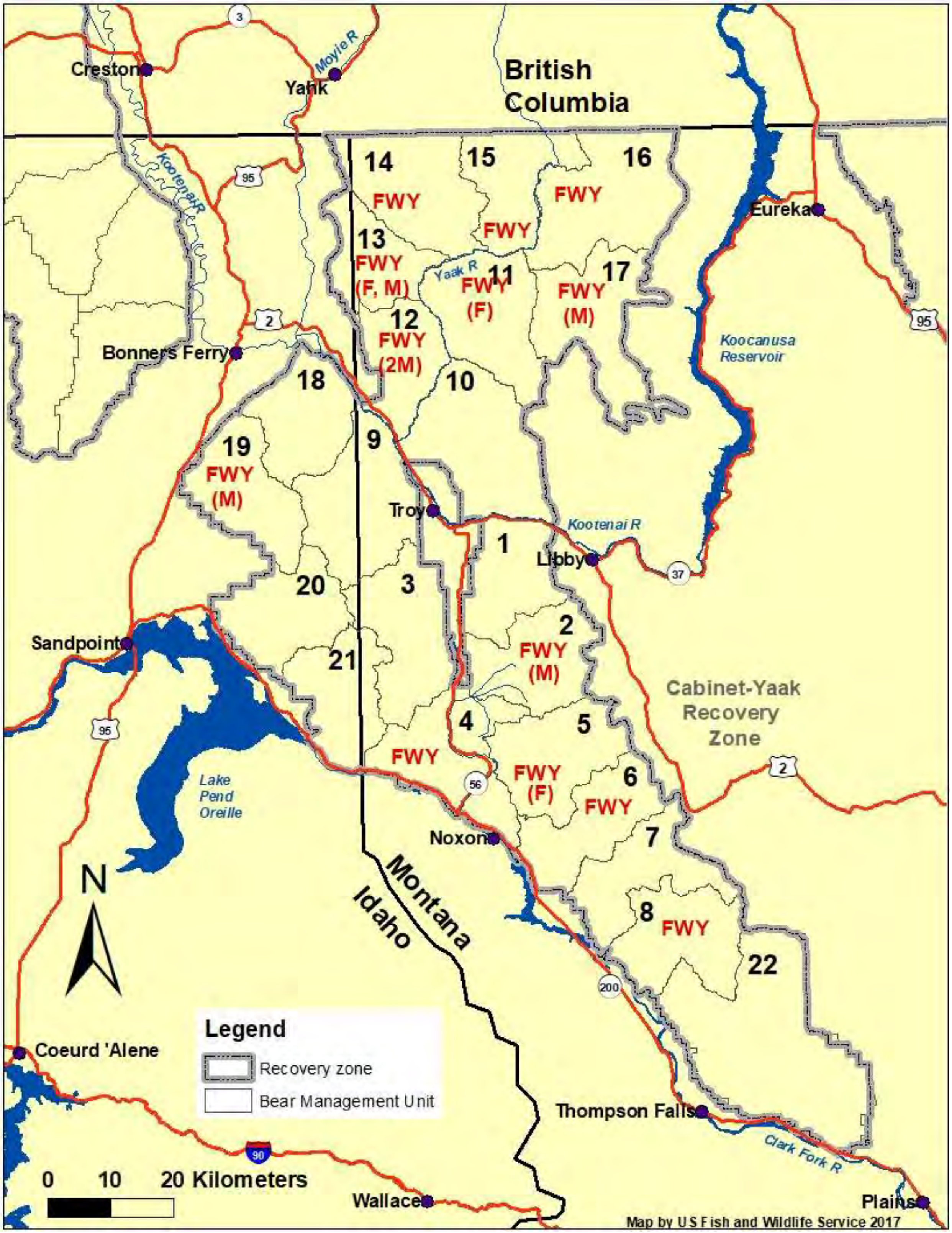

Figure 4. Female with young occupancy and known or probable mortality within Bear Management Units (BMUs) in the Cabinet-Yaak recovery zone 2015–2020. (FWY is occupancy of a female with young and sex of any mortality is in parentheses).

Table 5. Credible observations of females with young in or within 10 miles of the Cabinet-Yaak recovery zone, 1988–2020. Canadian credible observations shown in parentheses.

Year	Total credible[1] sightings females with young	Unduplicated females with cubs	Unduplicated females with yearlings or 2-year-olds	Unduplicated adult females without young	Minimum probable adult females[2]
1990	9	1	2	0	3
1991	4	1	1	1	2
1992	8	1	5	1	6
1993	6	2	1	0	3
1994	5	1	2	0	3
1995	8	1	2	0	3
1996	5	1	1	0	2
1997	14 (1)	3	4	0	7
1998	6 (1)	0	2 (1)	2	2 (1)
1999	2	0	2	3	2
2000	6 (1)	2 (1)	1	0	3 (1)
2001	5 (2)	1 (1)	3	0	4 (1)
2002	10 (1)	4 (1)	1	0	5 (1)
2003	11	2	4	0	6
2004	11	1	4	0	5
2005	10 (1)	1	4 (1)	1	5 (1)
2006	7 (1)	2 (1)	2	1	4 (1)
2007	17	4	2	2	6
2008	7 (1)	3 (1)	3	1	6 (1)
2009	5 (0)	2 (0)	2 (0)	1	4 (0)
2010	14 (0)	4 (0)	2 (0)	1	6 (0)
2011	4 (0)	1 (0)	1 (0)	1	2 (0)
2012	12 (0)	3 (0)	3 (0)	0	6 (0)
2013	9 (0)	2 (0)	5 (0)	0	7 (0)
2014	20 (1)	3 (0)	3 (0)	1	7 (0)
2015	19 (1)	2 (0)	5 (0)	2	9 (0)
2016	11 (0)	3 (0)	3 (0)	2	8 (0)
2017	8 (0)	3 (0)	3 (0)	2	8 (0)
2018	20 (0)	5 (0)	2 (0)	1	8 (0)
2019	10 (0)	2 (0)	5 (0)	1	8 (0)
2020	14 (1)	5 (0)	4 (0)	1	10 (0)

[1]Credible sightings are those rated 4 or 5 on a 5 point scale (see page 8).
[2]Minimum does not count females detected by mortality.

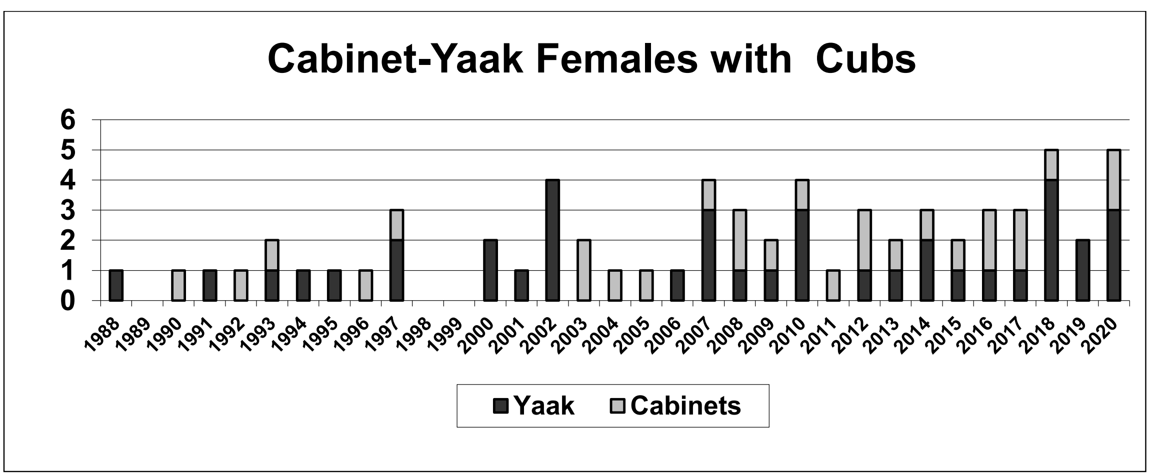

Figure 5. Credible observations of females with cubs in or within 10 miles of the Cabinet-Yaak recovery zone (excluding Canada), 1988–2020. Credible sightings rated 4 or 5 on a 5 point scale.

Table 6. Occupancy of bear management units by grizzly bear females with young in the Cabinet-Yaak recovery zone 1990–2020.

	1 - CEDAR	2 - SNOWSHOE	3 - SPAR	4 - BULL	5 - ST. PAUL	6 - WANLESS	7 - SILVER BUTTE	8 - VERMILION	9 - CALLAHAN	10 - PULPIT	11 - RODERICK	12 - NEWTON	13 - KENO	14 - NW PEAK	15 - GARVER	16 - E FORK YAAK	17 - BIG CREEK	18 - BOULDER	19 - GROUSE	20 - N LIGHTNING	21 - SCOTCHMAN	22 - MT HEADLEY
1988	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N
1989	N	N	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	N	N	N	N	N	N	N
1990	N	Y	N	N	N	N	N	Y	N	N	Y	Y	N	Y	Y	N	N	N	N	N	N	Y
1991	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
1992	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	N
1993	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
1994	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	Y	N	N
1995	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	N	N	N
1996	N	N	N	N	N	Y	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N
1997	N	Y	N	Y	N	Y	Y	N	N	N	Y	N	N	Y	Y	Y	N	N	N	N	Y	N
1998	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	N	N
1999	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N
2000	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
2001	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y	N	N	N	N	N
2002	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N
2003	N	Y	N	N	Y	Y	N	N	N	N	N	N	Y	N	N	Y	N	Y	N	N	Y	N
2004	N	Y	N	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
2005	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N
2006	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
2007	N	N	Y	Y	Y	Y	N	N	N	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N
2008	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	N
2009	N	N	N	Y	Y	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
2010	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N
2011	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	Y	N	Y	N	N	N	N	N
2012	N	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	N	N	N
2013	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	Y	Y	Y	Y	N	N	N	N	N
2014	N	N	N	N	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	N	N	N
2015	N	N	N	N	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N
2016	N	N	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	N	N	N	N
2017	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	N
2018	N	N	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N
2019	N	N	N	Y	Y	N	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	N	N	N
2020	N	Y	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N

Cabinet Mountains Population Augmentation

No bears were transported into the Cabinet Mountains during 2020. None of the bears captured in the Flathead drainage met our criteria for suitable candidate bears. One captured female had a conflict history that made her unsuitable.

Three bears were monitored during 2020, including a two year-old male released in 2018, a two year-old female released in 2019, and a three year-old male also released in 2019.

Bear 927was released in 2018 and monitored through early August of 2020. He was released in the West Cabinet Mountains but moved south of the Clark Fork River in July before being photographed at a black bear bait site on private property in late August of 2018. Landowner concerns prompted Idaho Fish and Game to capture the bear and it was released in the East Cabinet Mountains near the Wilderness. The bear returned to the area south of the Clark Fork River but did not revisit the bait site and spent most of September and October in Montana where black bear baiting is not allowed. The bear moved north of the Clark Fork River in November and denned in the West Cabinet Mountains in 2018. In late March of 2019, he emerged from his den and moved south, crossing the Clark Fork River in late April. He

continued south crossing Interstate 90 (I-90) in early June and US Highway 12 in early July. He spent much of July, August, and early September in the Selway Bitterroot Wilderness before returning to the Cabinet Mountains Wilderness where he denned in mid-December (Figure 6). This is the first confirmed instance of a grizzly bear in the Selway-Bitterroot Wilderness in over 50 years. He emerged from his den in April of 2020 and moved northeast into the Whitefish Range east of Eureka, MT where he spent the summer prior to losing his radio collar in early August. The collar was retrieved and downloaded to provide some additional location data that was not transmitted through the Iridium system. One of the major features crossed during his movements south and north was the crossing of I-90. On the southbound leg of his route, he crossed this divided highway about 1 km east of DeBorgia, MT and on the northbound leg crossed approximately 4 km west of St. Regis, MT. Both crossings appeared to occur in an area of the divided highway where vegetation occurred in the median between the two lanes of traffic providing some degree of cover. Both crossings occurred during the hours of darkness.

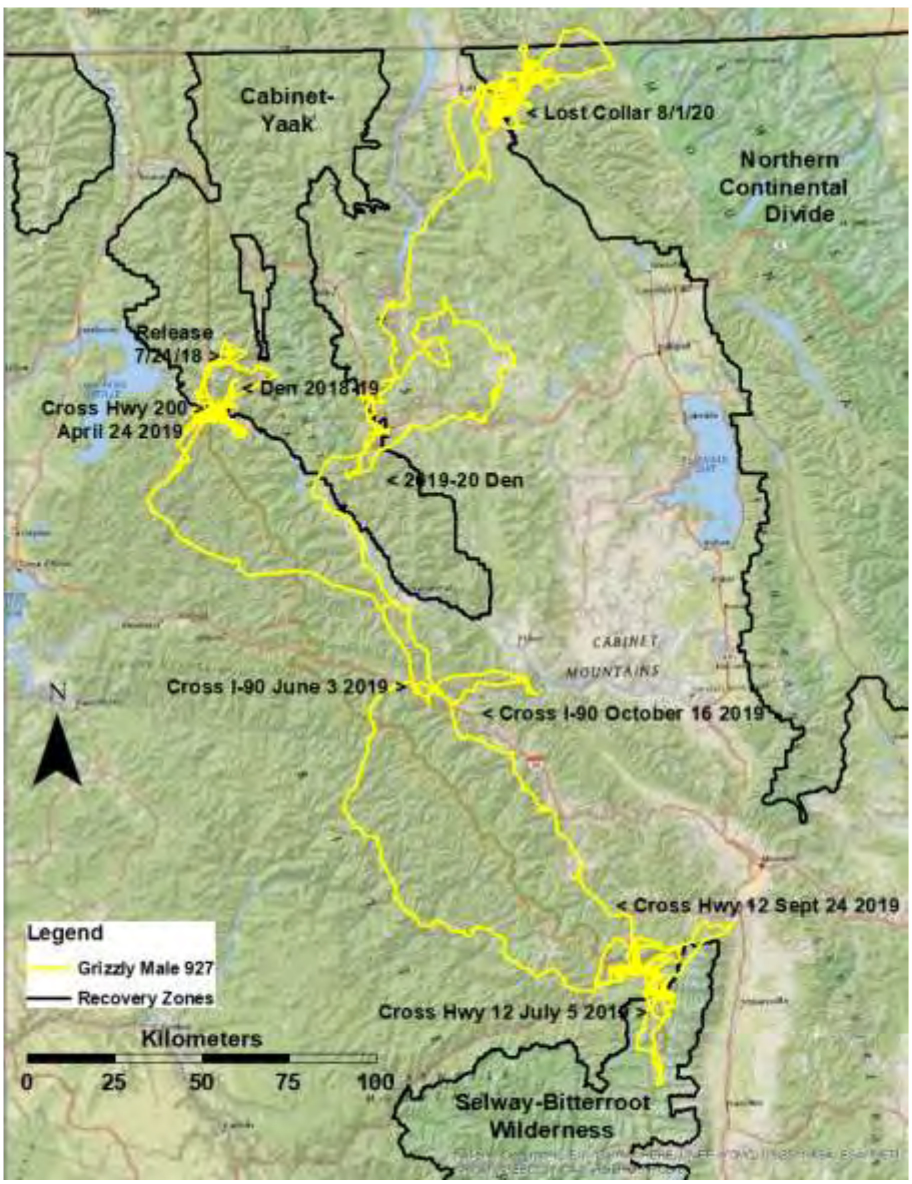

Figure 6. Movements of male augmentation bear 927, 2018-2020.

The female released in 2019 remained in the West Cabinet Mountains prior to denning approximately 4 miles west of her release site. During 2020 she continued her movement patterns in the West Cabinet Mountains on both side of the Idaho and Montana border. The male bear released in 2019 initially moved north and spent much of the summer just north of the Kootenai River before returning to the West Cabinets in early October. The bear was observed numerous times by landowners northwest of Clark Fork, ID, before moving to the Cabinet Mountains Wilderness to den in mid-December of 2019. After his emergence in 2020 he was sighted by several residents in the Lake Creek drainage before moving north and once again crossed the Kootenai River and then Koocanusa Reservoir while moving to the east through the Salish Range. In early June he was shot and killed at a farm northwest of Whitefish, MT. That incident is under investigation.

In summary, four female grizzly bears were captured in the Flathead River of British Columbia and released in the Cabinet Mountains from 1990–1994 (Table 7). Twenty-two different grizzly bears were captured during 840 trap-nights to obtain the 4 subadult females. Capture rates were 1 grizzly bear/38 trap-nights and 1 suitable subadult female/210 trap-nights. One transplanted bear and her cub died of unknown causes one year after release. The remaining three bears were monitored until collars dropped. The program was designed to determine if transplanted bears would remain in the target area and ultimately contribute to the population through reproduction. Three of four transplanted bears remained in the target area for more than one year. One of the transplanted bears produced a cub but had likely bred prior to translocation and did not satisfy our criteria for reproduction with resident males. One other female was known to have reproduced. In 2005 the augmentation program was reinitiated through capture by MFWP personnel and monitoring by this project. During 2005–2020, 10 female and 8 male grizzly bears were released in the Cabinet Mountains (Table 7).

Of 22 bears released through 2020, eight are known to have left the target area (one was recaptured and brought back, two returned in the same year, and one returned a year after leaving), three were killed within 4 months of release, one was killed within 10 months of release, and one was killed 16 years after release. One animal was known to have produced at least 10 first-generation offspring, 16 second-generation offspring, and one third-generation offspring. Another female was known to have produced three offspring and a male was known to have produced one offspring. See the genetic results portion of this report for more details.

Table 7. Sex, age, capture date, capture location, release location, and fate of augmentation grizzly bears moved to the Cabinet Mountains, 1990–2020.

Bear	Sex	Age	Capture date	Capture Location	Cabinet Mtns Release Location	Fate
218	F	5	7/21/1990	NF Flathead R, BC	EF Bull River	Den Cabinet Mtns 1990, Lost collar Aug. 1991, observed July 1992.
258	F	6	7/21/1992	NF Flathead R, BC	EF Bull River	Den Cabinet Mtns 1992 Produced 1 cub 1993, Natural mortality July 1993.
286	F	2	7/14/1993	NF Flathead R, BC	EF Bull River	Den Cabinet Mtns 1993–95 Lost collar at den Apr. 1995, hair snag 2004–2009, self-defense mortality November 2009.
311	F	3	7/12/1994	NF Flathead R, BC	EF Bull River	Lost collar July 1994, recaptured Oct. 1995 south of Eureka, MT, released EF Bull River, Signal lost Nov. 1995.
A1	F	7-8	9/30/2005	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2005–06, Lost collar Sept. 2007.
782	F	2	8/17/2006	SF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2006–07, Lost collar Aug. 2008.

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Bear	Sex	Age	Capture date	Capture Location	Cabinet Mtns Release Location	Fate
635	F	4	7/23/2008	Stillwater R, MT	EF Bull River	Killed by train near Heron, MT Oct. 2008.
790	F	3	8/7/2008	Swan R, MT	EF Bull River	Illegally killed near Noxon, MT Oct. 2008.
715	F	10	9/17/2009	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2009–10, returned to NF Flathead R, May 2010. Lost collar June 2010.
713	M	5	7/18/2010	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2010, Lost collar Sept. 2011.
714	F	4	7/24/2010	NF Flathead R, MT	Silverbutte Cr	Returned to NF Flathead July 2010. Lost collar Oct. 2013.
725	F	2	7/25/2011	MF Flathead R, MT	Spar Lake	Moved to Glacier National Park, Sept. 2011 den, returned to Cabinet Mtns Aug. 2012 and den, moved to Glacier National Park and returned to Cabinet Mtns, lost collar Oct. 2013
723	M	2	8/18/2011	Whitefish R, MT	Spar Lake	Den Cabinet Mtns 2011. Lost collar June 2012.
918	M	2	7/6/2012	Whitefish R, MT	EF Bull River	Den Cabinet Mtns 2012–-13. Lost collar Oct. 2014.
919	M	4	7/30/2013	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2013. Lost collar Aug. 2014.
920	F	2	6/18/2014	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2014–15.
921	F	2	6/18/2014	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2014. Died of unknown cause May 2015.
924	M	2	7/25/2015	SF Flathead R, MT	Spar Lake	Mistaken identity mortality Sept. 2015
926	M	3	7/25/2016	SF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2016. Lost collar July 2017
927	M	2	7/20/2018	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2018 and Cabinet Mtns 2019, lost collar August 2020
923	F	2	7/12/2019	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2019 and 2020
892	M	3	7/14/2019	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2019, killed June of 2020 near Whitefish, MT

Cabinet-Yaak Hair Sampling and DNA Analysis

Hair snag sampling occurred at barb wire corrals baited with a scent lure during 2000–2020 (Table 8 and Fig. 7). Sampling occurred from May–October but varied within years. Sites were selected based on prior grizzly bear telemetry, sightings, and access. Remote cameras supplemented hair snagging at most sites and were useful in identifying family groups and approximate ages of sampled bears. Genetic analysis from 2020 field collected samples is not yet complete; we will report on these results in the 2021 report. In 2002, study personnel assisted a MFWP black bear population estimate effort that sampled 285 sites in the Yaak River portion of the CYE. During 2003, 184 sites on a 5 km^2 grid were sampled on 4,300 km^2 in the Cabinet Mountains portion of the CYE. In 2009, 98 sites were sampled south of the Clark Fork River. In 2012, United States Geological Survey (USGS) researchers completed an ecosystem-wide mark-recapture population estimate using DNA from hair collected at more than 850 corrals. Other years had much lower numbers of sampled sites. Collectively, USFWS, USGS, and MFWP crews have sampled 2,085 corral traps from 2000–2020 (Table 8 and Fig. 7). Through 2019, corral traps alone were successful during six percent of site visits and provided hair from at least 74 grizzly bears.

Table 8. Hair snagging corrals and success in the Cabinet-Yaak study area, 2000–2020. DNA genetic results not yet complete for 2020 samples.

Year	Number of corral sessions[1]	Sessions with grizzly bear DNA(%[2])	Sessions with grizzly bear photos or DNA(%[2])	Individual grizzly bear genotypes	BMUs with grizzly bear pictures or hair	Comments
2000	1	0	0	0		
2001	3	0	0	0		
2002	319	9 (3)	10 (3)	9	BMUs 2, 5, 6, 12, 14, 16, 17	
2003	184	1 (1)	1 (1)	1	BMUs 5, 6	
2004	14	2 (14)	2 (14)	3	BMU 5	
2005	17	1 (6)	2 (12)	1	BMU 5	
2006	19	3 (16)	3 (16)	3	BMUs 3, 5, 7	
2007	36	4 (11)	5 (14)	9	BMUs 5, 11, 13	Female with young BMU 5
2008	21	1 (5)	1 (5)	1	BMU 5	
2009	125	2 (2)	4 (3)	4	BMUs 5, 6, 9	Female with young BMU 5
2010	27	3 (11)	4 (15)	5	BMUs 3, 5, 6	Female with young BMU 5
2011	72	9 (13)	12 (17)	13	BMUs 3, 4, 5, 6, 11, 13, 14, 15, 16, 17	Female with young BMU 16
2012	854	48 (6)	48 (6)	29	BMUs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20	
2013	5	2 (40)	2 (40)	2	BMUs 2, 3, 5, 6, 7, 11, 13, 14, 15, 16, 17	Female with young BMU 6
2014	41	3 (7)	8 (7)	4	BMUs 1, 2, 3, 5, 6, 11, 12, 13, 14, 15, 16, 17, 19	Female with young BMU 13
2015	72	5 (7)	12 (17)	7	BMUs 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16, 17	Female with young BMU 13 Female with cubs BMU 5
2016	39	6 (15)	9 (23)	10	BMUs 2, 3, 5, 6, 7, 10, 11, 13, 14, 15, 16, 17, 19	Female with young BMU 13, 5 Female with cub BMU 16
2017	92	18 (20)	18 (20)	18	BMUs 1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17	Female with cubs BMU 5 Female with young BMU 5
2018	55	13 (24)	16 (29)	17	BMUs 1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17	Female with cubs BMU 5, 13, 14 Female with young BMU 6
2019	49	6(12)	11 (22)	6	BMUs 4, 5, 6, 8, 10, 13	Female with young BMU 13
2020	40	--	13 (33)[3]	--	BMUs 5, 11, 12, 13, 14, 16	Female with cubs BMU 12 Female with young BMU 11,13, 16
Total	2085	136 (7)	181 (9)	74[4]		

[1]Some corral sites were deployed for multiple sessions per year. A "session" is typically 3-4 weeks long and defined as the interval between site set-up and revisits to collect samples and photos.
[2]Percent success at all corral sessions
[3]Sites with photos only. Awaiting 2020 genetic results.
[4]Some individuals captured multiple times among years.

In 2020, we collected 415 samples from 453 visits to 346 individual rub trees (Table 9). Samples were evaluated during cataloging and 269 were judged to be black bears (based on solid black coloration), leaving 146 to be sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Lab analysis on 2020 samples is still in progress, and we will report on results in the 2021 report. From 2013–2019, we genetically identified 79 individual grizzly bears (50 males, 29 females) from 15,803 samples collected via rub effort alone.

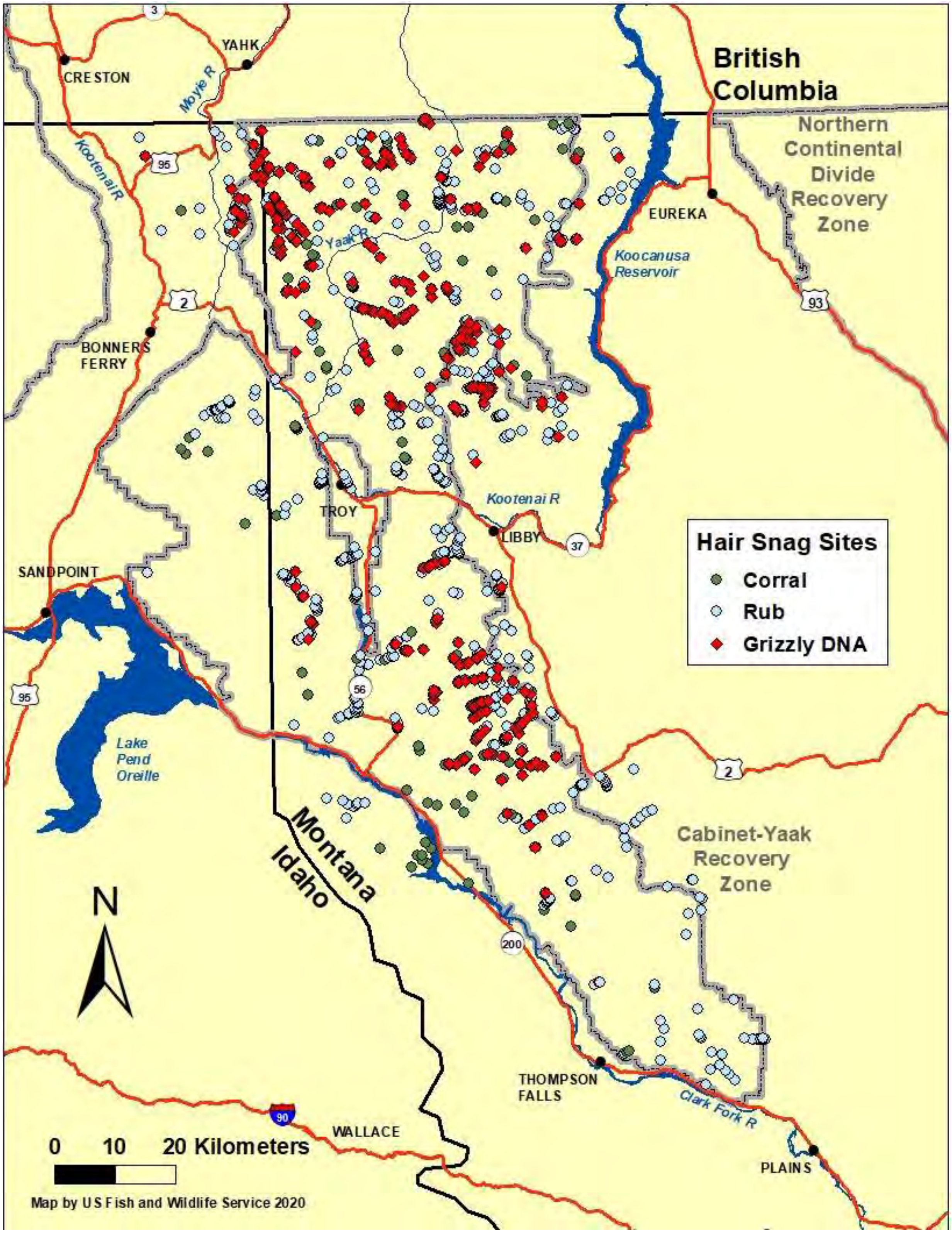

Figure 7. Location of hair snag sample sites in the Cabinet-Yaak Ecosystem study area, 2013–2020. Sites with grizzly bear DNA are identified (2013–2019).

Table 9. Grizzly bear hair rubs and success in the Cabinet-Yaak study area, 2012–2020.

Year	Number of rubs checked[4]	Number of samples collected (%GB[1])	Number of samples sent to Lab (%GB[1])	Number of rubs with grizzly DNA	Individual grizzly bear genotypes	Males	Females
2012[2]	1376	8356 (2)	4639 (3)	85	33	19	14
2013	488	1038 (6)	480 (12)	33	17	9	8
2014	583	1894 (7)	708 (19)	50	24	14	10
2015	693	2258 (6)	617 (22)	76	30	20	10
2016	780	3781 (5)	1049 (19)	90	29	18	11
2017	836	2958 (13)	676 (55)	147	38	24	14
2018	782	2267 (8)	481 (38)	96	37	23	14
2019	845	2167 (7)	440 (33)	85	30	25	5
2020	346	415 (--)	146 (--)	--	--	--	--
Total[3]	1696[4]	24719 (6)	9090 (15)	334[4]	87[5]	57[5]	30[5]

[1] Percentage of samples yielding a grizzly bear DNA genotype.

[2] 2012 results from USGS population estimation study (Kendall et al. 2016). 2013-20 efforts are from USFWS coordinated efforts.

[3]Totals are through 2019. 2020 genetic results from the lab are not yet complete.

[4] Unique rub locations. Some rub locations visited multiple times among years.

[5]Some individuals captured multiple times among years.

Grizzly Bear Genetic Sample Summary

We provide data leading up to and including 2019 as 2020 sample results have not been completed by the laboratory. Using all methods (capture, collared individuals, all sources of DNA sampling, photos, credible observations), we detected a minimum of 50 individual grizzly bears alive and in the CYE grizzly bear population at some point during 2019. Five of these bears were known dead by end of 2019. Twenty-three bears were detected in the Cabinets (16 male, 7 female). Twenty-seven bears were detected in the Yaak (16 male, 7 female, 4 unknown sex).

Captures, genotypes, and observations of grizzly bears by study personnel in the CYE study area were summarized during 1986–2019. Individuals not radio-collared or genotyped were conservatively separated by size, age, location, coloration, or reproductive status. Conservative classification of sightings may result in unique individuals being documented as one individual. Individual status or relationships may change with new information.

Two hundred twenty-one individuals were identified within the CYE study area during 1986–2019 (192 bears captured or genotyped and 29 unmarked individuals observed). Fifty were known to be alive during 2019.

We determined parent-offspring relationships of Yaak grizzly bears using sample genotypes from 1986–2019. A majority of our detected sample in the Yaak descends from female grizzly bear 106 (Figure 8). She produced five known litters, and her matrilines tie to 58 known first, second, and third generation offspring. In 2018, we identified her first fourth generation offspring, male Y38004M, presumed dead in 2019. In 2019, two more fourth generation cubs were detected (cub-of-the-year offspring of female 842). Both died in 2019 (natural mortality). Since 1986, we have genetically detected 41 female grizzly bears in the US Yaak and BC Yahk, 28 (68%) of which are direct maternal descendants of bear 106. Since 2014, all female bears detected in the US Yaak are her maternal descendants. In 2015–2019, we detected 1 daughter, 7 granddaughters, and 5 great-granddaughters of 106.

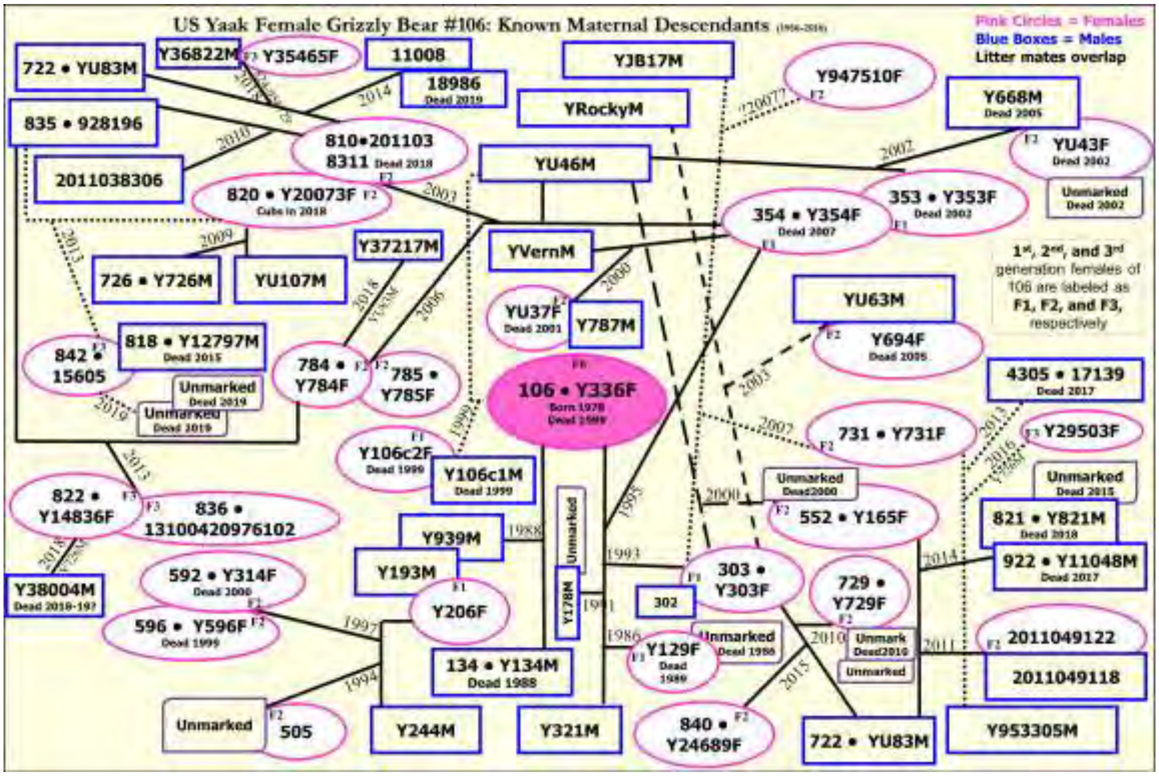

Figure 8. Most likely pedigree displaying matrilineal ancestry of female grizzly bear 106 in the Yaak River, 1986–2019. Squares indicate males and circles represent females. Lines indicate a parent-offspring relationship. F0 is the initial generation, F1 the first generation, F2 the second generation, and F3 the third generation. Numbers along lines indicate when the descendant litter was produced.

Claws from a grizzly bear were discovered in Baree Creek of the Cabinet Mountains in 1993. Analysis of DNA from these claws matched bear 678 originally captured in the Cabinet Mountains in 1983 when 28 years old. Tissue present on the claws suggested that she died no earlier than 1992. Bear 678 would have been at least 37 years old at the estimated time of death. Pedigree analysis also indicated that the three bears captured in the Cabinet Mountains from 1983–1988 were a triad with bear 680 being the offspring of bears 678 and 14.

The Cabinet Mountains population was estimated to be 15 bears or fewer in 1988 on the basis of independent tracks, sightings, and expert opinion (Kasworm and Manley 1988). However, lack of resident bears identified since 1989 suggests the population was well below 15 individuals. Genetic samples from the Cabinet Mountains (1983–2019) were determined to originate from 76 different grizzly bears. Three of these were from captures during 1983–1988, 21 were from augmentation bears during 1990–2019 (1 augmentation bear 218 genetically unmarked), and 54 from captures, mortalities, or hair snagging during 1997–2019.

One of these genotypes identified by hair snagging was from grizzly bear 286. She was released in the Cabinet Mountains as part of population augmentation in 1993 as a 2-year-old (Kasworm *et al.* 2007). She was 13 years old when the first hair sample was obtained during 2004. Pedigree analysis indicates she has produced at least 10 first generation offspring, 22 second generation offspring, and 4 third generation offspring. Six of those first-generation offspring were females, and all 6 are known to have reproduced (Fig. 9). Bear 286 was killed in a self-defense incident with a hunter in November of 2009.

The augmentation effort appears to be the primary reason grizzly bears remain and are increasing in the Cabinet Mountains. Only 15 genotyped bears not known to be augmentation

bears or their offspring have been identified in the Cabinet Mountains since 1990 and seven are known dead. The following describes each individual and fate. Two are adult males that bred with 286 to produce first generation of augmentation offspring. Four are a family group (adult female with 3 cubs) identified south of the Clark Fork River in 2002. The adult female and one of the young are known dead. Three are males with past human-bear conflict histories in the Northern Continental Divide population (NCDE) to the northeast and subsequently traveled to the CYE in 2014–2018, including: 1) an adult male killed in self-defense in the Little Thompson River in 2014, 2) a subadult male caught in Flathead Valley in spring of 2016, traveled to Cabinets fall 2016 or spring 2017, and traveled back toward NCDE and died by poaching in May 2017, 3) subadult male caught spring 2018 between the NCDE and Cabinets, relocated into the Yaak and soon thereafter died by human-cause (under investigation) in May 2018. One bear was a subadult male captured near Thompson Falls in 2011 in an incident involving livestock depredation, unknown status thereafter. Two bears were male migrants from the Selkirk Mountains: 1) identified in 2012, who is now known to have moved back to the Selkirks before breeding, has bred and remains in Selkirks in 2018, 2) a collared subadult male with movement in 2018 but lost collar in fall 2018. One bear was a subadult male migrant from the NCDE with no conflict history, caught in 2019 in Cabinets, and spent much time in the Salish range before casting collar, fate unknown. The remaining two bears were adult males born in 2008 and 2009 in the Yaak and identified in the Cabinets in 2016 and 2019.

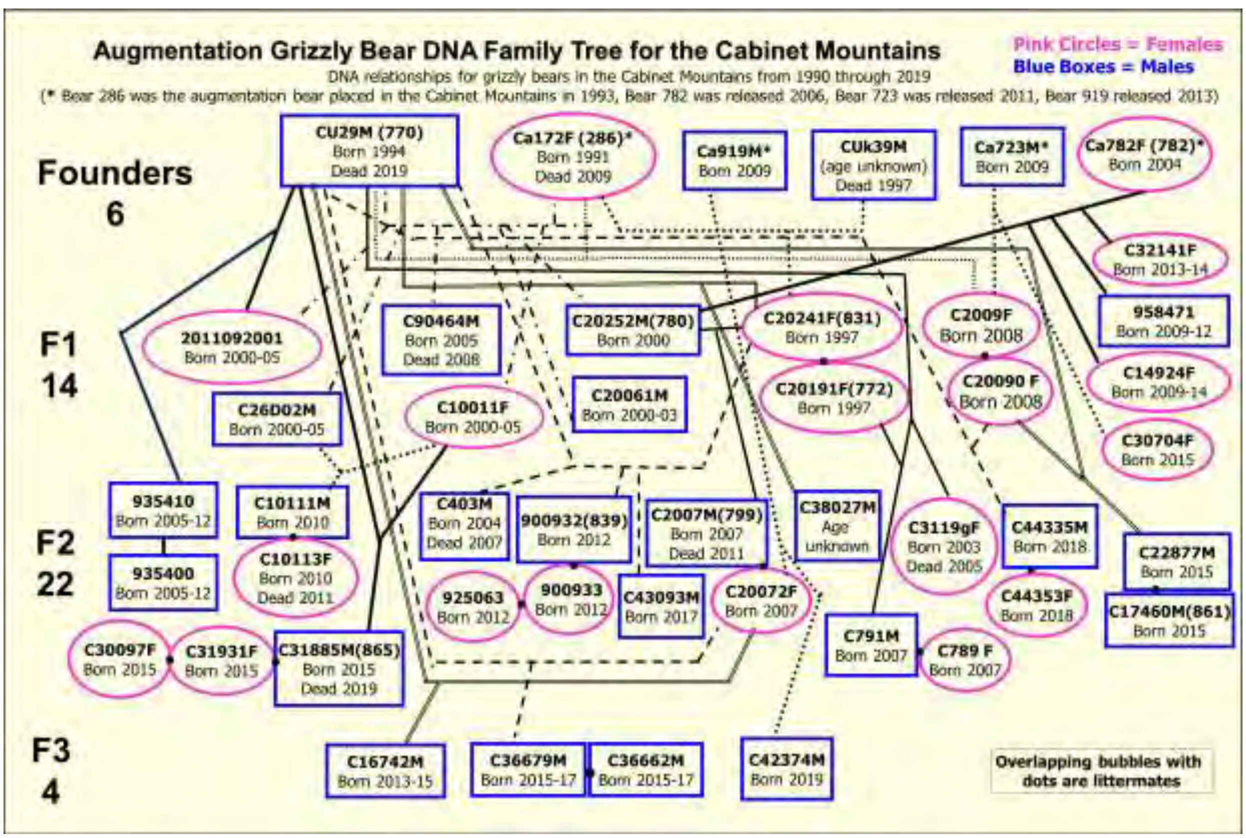

Figure 9. Most likely pedigree resulting from translocated female grizzly bears 286 and 782 in the Cabinet Mountains, 1993–2019. Squares indicate males and circles represent females. Lines indicate a parent-offspring relationship. F0 is the initial generation, F1 is the first generation of offspring for translocated females 286 or 782 and male 723, F2 is the second generation and F3 is the third generation.

Grizzly Bear Movements and Gene Flow Within and Between Recovery Areas

Population linkage is a goal of the CYE recovery plan (USFWS 1993). The population goal of approximately 100 animals requires genetic connectivity to maintain genetic health over time. Movement data from telemetry or genetic methods may be a precursor of linkage, but gene flow through reproduction by immigrant individuals is the best measure of connectivity.

Capture, telemetry, and genetic data were analyzed to evaluate movement and subsequent reproduction resulting in gene flow into and out of the CYE. Forty-one grizzly bears were identified as immigrants, emigrants, or offspring of immigrants to the CYE from 1983–2019 (Appendix Table T4). While movement and gene flow out of the CYE may benefit other populations, gene flow into the CYE is most beneficial to genetic health. Seventeen individuals (14 males and 3 females) are known to have moved into the CYE from adjacent populations; however, eight of these were killed, removed, or emigrated out of the CYE prior to any known gene flow (Figure 10). Ten of these immigrants originated from the North Purcells (3 known mortalities), five from the NCDE (three known mortalities), and two from the South Selkirks (one known mortality). Gene flow has been identified through reproduction by three immigrants from the North Purcells (two males and one female) resulting in 4 offspring in the CYE.

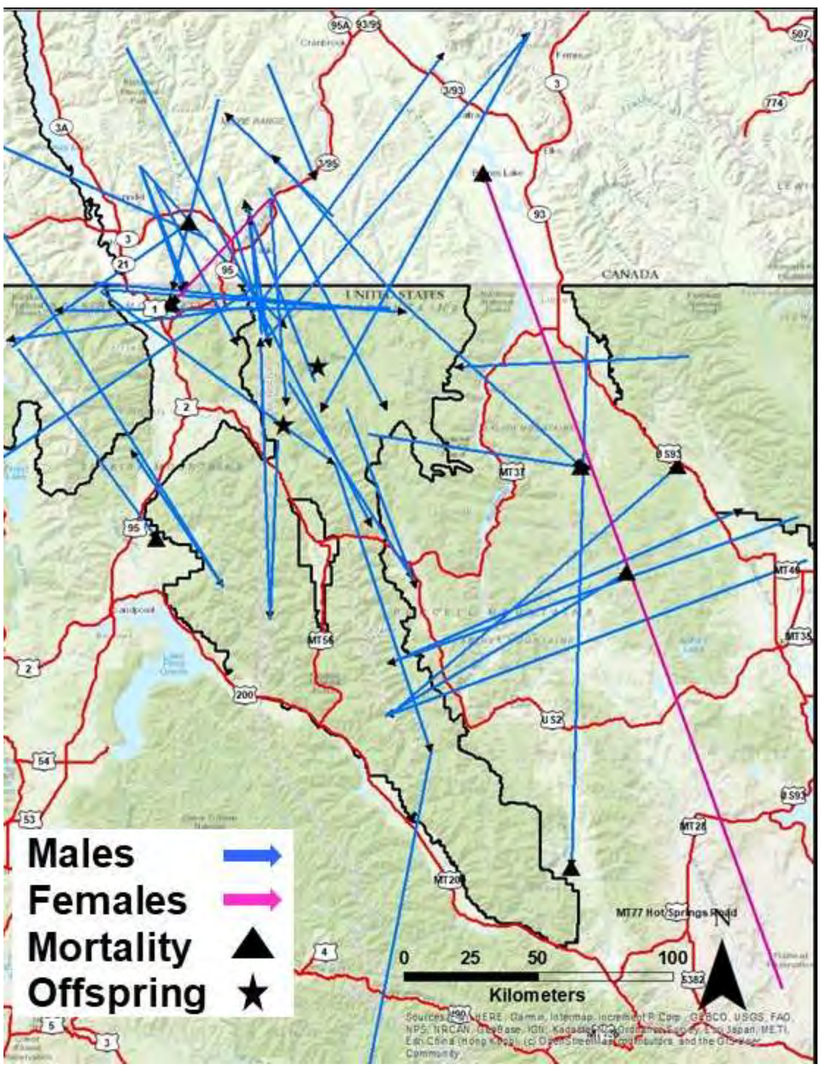

Figure 10. Known immigration or emigration events (blue and pink lines) and gene flow (black stars) in the Cabinet-Yaak, 1988–2020

Known Grizzly Bear Mortality

There were three instances of known or probable grizzly bear mortality in or within 16 km of the CYE (including BC) during 2020 (one subadult male and two adult females). The subadult male mortality was the result of mistaken identity by a black bear hunter. This animal had a wire neck snare around the neck that may have ultimately killed the bear later in life. One adult female died as a result of self-defense (BC) and another is human caused, but under investigation. Two cubs classified as mortalities in 2018 when their mother was killed, were removed from the mortality list after it was determined that they survived into 2019 based on photographic and genetic evidence. Sixty-four instances of known and probable grizzly bear mortality from all causes were detected inside or near the CYE (excluding Canada) during 1982–2020 (Tables 1 and 10, Fig. 11). Forty-six were human caused, 15 were natural mortality, and 3 were unknown cause. There were 19 instances of known grizzly bear mortality in Canada within 16 km of the CYE in the Yahk and South Purcell population units from 1982–2020 (Tables 1 and 10, Fig. 11). Fourteen were human-caused and 5 were natural mortalities.

Table 10. Cause, timing, and location of known and probable grizzly bear mortality in or within 16 km of the Cabinet-Yaak recovery zone (including Canada), 1982–2020. Radio collared bears included regardless of mortality location.

	Mortality cause											
Country/ age / sex / season / ownership	Defense of life	Legal Hunt	Hound hunting	Management removal	Mistaken identity	Natural	Poaching	Trap predation	Vehicle collision	Unknown, human	Unknown	Total
U.S.												
Age / sex												
Adult female	4					2	1		1	3	1	12
Subadult female						1	1	1	2	3		8
Adult male	2			2	1		2			4		11
Subadult male	2				5		2			4	1	14
Yearling					1	1					1	3
Cub					1	9	2			3		15
Unknown					1							1
Total	7			1	9	13	8	1	3	17	3	64
Season[1]												
Spring					1	3	1			4	1	10
Summer	1				1	10	1	1				14
Autumn	7			2	7		5		3	12		36
Unknown							1			1	2	4
Ownership												
US Private	3			2	2		5		3	6	1	22
US Public	5				7	13	3	1		11	2	42
Canada												
Adult female	1			2								3
Subadult female	1							1				2
Adult male	1	1		2	1					1		6
Subadult male				1						1		2
Yearling						1						1
Cub						4						4
Unknown			1									1
Total	3	1	1	5	1	5		1		2		19
Season[1]												
Spring	1	1		1		1		1				5
Summer			1	1		4						6
Autumn	2			3	1					2		8
Unknown												
Ownership												
BC Private				4								4
BC Public	3	1	1	1	1	5		1		2		15

[1]Spring = April 1 – May 31, Summer = June 1 – August 31, Autumn = September 1 – November 30

Sixty-four percent (16 of 25) of known human-caused mortalities occurring on the US National Forests were <500m of an open road from 1982–2020. Thirty-six percent (9 of 25) of known human-caused mortalities occurring on National Forests were located within core habitat (area greater than 500m from an open or gated road).

Mortality rates were examined by breaking the data into periods of increase (1982–1998, 2007–2020) and decrease (1999–2006) in population trend. From 1982–1998, 16 instances of known mortality occurred in the U.S. and Canada, with 12 (75%) of these mortalities being human-caused (Table 1). The annual rate of known human-caused mortality was 0.71 mortalities per year. Twenty-seven instances of known mortality occurred during 1999–2006 with 18 (67%) of these human-caused. Annual rate of known human-caused mortality was 2.25 per year. Forty instances of known mortality occurred from 2007–2020 with 30 (75%) of these human-caused. Annual rate of known human-caused mortality was 2.073 per year. Though the rate of known human caused mortality was similar between the two most recent time periods, it is important to consider the rate of female mortality. The loss of females is the most critical factor affecting the trend because of their reproductive contribution to current and future growth. The rate of known female mortality was 0.29 and human caused female mortality was 0.18 during 1982–1998. Both total known female and human-caused female mortality rate increased from 1982–1998 to 1999–2006 periods. Total known female mortality rate decreased from 1.88 during 1999–2006 to 0.79 during 2007–2020 and known human-caused female mortality rate decreased from 1.5 to 0.57. This decline of female mortality is largely responsible for the improving population trend from 2007–2020 (Pages 39–42). Efforts to detect mortality were probably lowest during 1982–1998 because of fewer collared bears and less personnel presence in the Yaak portion of the recovery zone. Comparisons involving the two most recent time periods represent more similar amounts of effort to detect mortality.

The increase in total known mortality beginning in 1999 may be linked to poor food production during 1998–2004 (Fig. 11). Huckleberry production during these years was about half the long-term average. Poor berry production years can be expected at various times, but in this case, there were several successive years of poor production. Huckleberries are the major source of late summer food that enables bears to accumulate sufficient fat to survive the denning period and females to produce and nurture cubs. Poor nutrition may not allow females to produce cubs in the following year and cause females to travel further for food, exposing young to greater risk of mortality from conflicts with humans, predators, or accidental deaths. One female bear lost litters of 2 cubs each during spring of 2000 and 2001. Another mortality incident involved a female with 2 cubs that appeared to have been killed by another bear in 1999. The effect of cub mortality may be greatest in succeeding years when some of these animals might have been recruited to the reproductive segment of the population.

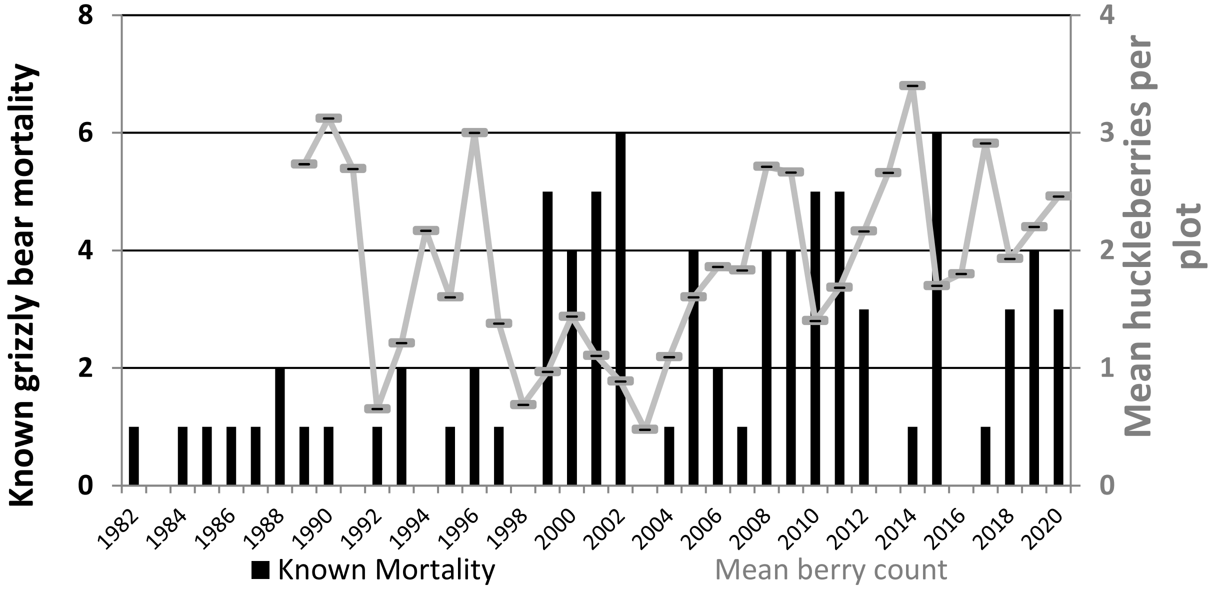

Figure 11. Known grizzly bear annual mortality from all causes in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and all radio-collared bears by cause, 1982–2020 and huckleberry production counts, 1989–2020.

Using counts of known human-caused mortality probably under-estimates total human-caused mortality. Numerous mortalities identified by this study were reported only because animals wore a radio-collar at death. The public reporting rate of bears wearing radio-collars can be used to develop a correction factor to estimate unreported mortality (Cherry *et al*. 2002). Correction factors were not applied to natural mortality, management removals, mortality of radio-collared bears or bears that died of unknown causes (Table 11). All radioed bears used to develop the unreported mortality correction were >2 years-old and died from human related causes. Twenty-three radio-collared bears died from human causes during 1982–2019. Eleven of these were reported by the public (55%) and 9 were unreported (45%). The Bayesian statistical analysis described by Cherry *et al*. (2002) was used to calculate unreported mortality in 3 year running periods in the Yellowstone ecosystem, but samples sizes in the CYE are much smaller, so we grouped data based on the cumulative population trend (ʎ, Fig. 11). The unreported estimate added 24 mortalities to the 83 known mortalities from 1982–2020. The unreported estimate includes bears killed in BC which are not counted in recovery criteria (USFWS 1993).

Table 11. Annual human-caused grizzly bear mortality in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and estimates of unreported mortality, 1982–2020 (including all radio-collared bears regardless of mortality location).

Years	Population trend	Natural	Management or research	Radio monitored	Unknown cause	Public reported	Unreported estimate	Total
1982-1998	Improving	3	2	4	1	6	5	21
1999-2006	Declining	9	4	7	0	7	6	33
2007-2020	Improving	8	3	11	2	16	13	53
Total		20	9	22	3	29	24	107

Grizzly Bear Survival, Reproduction, Population Trend, and Population Estimate

This report segment updates information on survival rates, cause-specific mortality, and population trend following the methods used in Wakkinen and Kasworm (2004).

Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival and cause-specific mortality rates were calculated for 6 sex and age classes of native grizzly bears from 1983–2019 (Table 12). We calculated survival and mortality rates for augmentation and management bears separately (see below).

Table 12. Survival and cause-specific mortality rates of native grizzly bear sex and age classes based on censored telemetry data in the Cabinet–Yaak recovery zone, 1983–2020.

	Demographic parameters and mortality rates					
Parameter	Adult female	Adult male	Subadult female	Subadult male	Yearling	Cub
Individuals / bear-years	17 / 50.6	28 / 38.4	20 / 25.3	24 /19.1	33 / 16.4	46 / 46[a]
Survival[b] (95% CI)	0.923 (0.852–0.994)	0.898 (0.804-0.991)	0.849 (0.711–0.987)	0.842 (0.683-01.0)	0.892 (0.748–1.0)	0.652 (0.497–0.787)
Mortality rate by cause						
Legal Hunt Canada	0	0.029	0	0	0	0
Natural	0.020	0	0	0	0.108	0.304
Defense of life	0	0.026	0.037	0.0370	0	0
Mistaken ID	0	0	0	0	0	0
Poaching	0.03619	0	0	0.049	0	0.043
Trap predation	0	0	0.042	0	0	0
Unknown human	0.020	0.047	0.073	0.071	0	

[a]Cub survival based on counts of individuals alive and dead.
[b]Kaplan-Meier survival estimate which may differ from BOOTER survival estimate.

Mortality rates of all sex and age classes of resident non-management radio-collared grizzly bears ≥2 years old were summarized by cause and location of death (Table 13). Rates were categorized by public or private land and human or natural causes. Rates were further stratified by death locations in BC or U.S. and broken into three time periods. The three periods (1983–1998, 1999–2006, and 2007–2020) correspond to a period of population increase followed by a period of decline followed by a period of increase in long term population trend (λ). Grizzly bear survival of all sex and age classes decreased from 0.899 during 1983–1998 to 0.792 during 1999–2006 and then rose to 0.924 during 2007–2020. Some of this decrease in the 1999–2006 period could be attributed to an increase in natural mortality probably related to poor berry production during 1998–2004. Mortality on private lands in the U.S. increased during this period, suggesting that bears were searching more widely for foods to replace the low berry crop. Several mortalities occurring during 1999–2006 were associated with sanitation issues on private lands. Declines in mortality rate on private lands beginning in 2007 correspond to and may be the result of the initiation of the MFWP bear management specialist position. Several deaths of management bears occurred on private lands but were not included in this calculation due to capture biases (traps were set only once a conflict occurred and removed after capture). Point estimates for human-caused mortality occurring on public lands in the U.S. and BC decreased from 1983–1998 to 1999–2006 and again from 1999–2006 to 2007–2020. This apparent decrease in mortality rates on public lands from 1983–1998 to 1999–2006 is particularly noteworthy given the increase in overall mortality rates. Implementation of access management on U.S. public lands could be a factor in this apparent decline.

Table 13. Survival and cause-specific mortality rates of native radio-collared grizzly bears ≥2 years old by location of death based on censored telemetry data in the Cabinet–Yaak recovery zone, 1983–2020.

Parameter	1983–1998	1999–2006	2007–2020
Individuals / bear-years	23 / 48.9	21 / 20.3	44 / 59.6
Survival[b] (95% CI)	0.899 (0.819–0.979)	0.792 (0.634–0.950)	0.924 (0.857–0.991)
Mortality rate by location and cause			
Public / natural	0	0.059	0
U.S. public / human	0.061	0.036	0.031
U.S. private / human	0	0.075	0.045
B.C. public / human	0.040	0.038	0
B.C. private / human	0	0	0

Augmentation Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival rates were calculated for 22 augmentation grizzly bears from 1990–2020. Fourteen female and eight male bears ranged in age from 2–10. Survival was calculated based on release week for each individual, as the common starting point and progressing by week until death or censor. Bears that left the target area were censored during that week from the survival calculation to obtain survival rates indicative of CYGBE conditions. Four females are known to have left the target area, but one returned while radio collared. Four females are known to have died within the target area. None of the augmentation males died within the target area. Four are known to have left the target area and two are known to have died outside the target area. All known female and male mortality occurred within the first-year post release.

First year annual survival rate for augmentation females was 0.600 (95% CI=0.296–0.904, *n* =14) with a natural mortality, a poaching, a train collision, and an unknown cause. The natural mortality occurred during spring, the unknown mortality occurred during summer, and the poaching, mistaken identity, and train mortality occurred during autumn. The female that died of unknown cause produced a cub before her death and it is assumed the cub died. Female survival for all years radio monitored was 0.746 (95% CI=0.555–0.936, *n* =14. No males died within the target area during their first year though two males were known to have died outside the target area (mistaken identification and a self-defense). Male survival for all years radio monitored was 0.771 (95% CI=0.531–1.0 *n* =8.

Management Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival rates were calculated for 16 management grizzly bears captured at conflict sites from 2003–2019. Fourteen bears were males and two were females aged 2–25. None of the females died during monitoring. Male survival rate was 0.479 (95% CI=0.265–0.694, *n* =14) with an instance of mistaken identity, a self-defense, two management removals, and one unknown but human-caused mortality among 16 radio-collared bears monitored for 8.3 bear-years. Two mortalities occurred during spring and four occurred during autumn.

Grizzly Bear Reproduction

Reproductive parameters originated from all bears monitored 1983–2020. Mean age of first parturition among native grizzly bears was 6.3 years (95% CI=5.9–6.7, *n* =14, Table 14). Five bears used in the calculation were radio-collared from ages 2–8. One individual was captured with a cub at age 6 years old. We assumed this was a first reproductive event given her age. Eight other first ages of reproduction were established through genetic parentage analysis and known age of offspring. Twenty-nine litters comprised of 62 cubs were observed through both monitoring radio-collared bears and known genetic parentage analysis paired with remote camera observation, for a mean litter size of 2.14 (95% CI=1.95–2.33, *n* =29, Table 14).

Twenty-five reproductive intervals were determined through monitoring radio-collared bears and known genetic parentage analysis paired with remote camera observation (Table 14). Mean inter-birth interval was calculated as 2.84 years (95% CI=2.41–3.27, *n* =24). Booter software provides several options to calculate reproductive rate (*m*) and we selected unpaired litter size and birth interval data with sample size restricted to the number of females. The unpaired option allows use of bears from which accurate counts of cubs were not obtained but interval was known, or instances where litter size was known but radio failure or death limited knowledge of birth interval. Estimated reproductive rate using the unpaired option was 0.361 female cubs/year/adult female (95% CI=0.286–0.467, *n* =12 adult females, Table 15). Sex ratio of cubs born was assumed to be 1:1. Reproductive rates do not include augmentation bears.

Table 14. Grizzly bear reproductive data from the Cabinet-Yaak 1983–2020.

Bear	Year	Age at first reproduction	Reproductive Interval[1]	Cubs	Cubs (relationship and fate, if known)
106	1986		2	2	1 dead in 1986, ♀ 129 dead in 1989
106	1988		3	3	♂ 192 dead in 1991, ♂ 193, ♀ 206
106	1991		2	2	2 cubs 1 male other unknown sex and fate
106	1993		2	2	♂ 302 dead in 1996, ♀ 303
106	1995		4	2	♀ 353 dead in 2002, ♀ 354 dead in 2007
106	1999			2	♀ 106 and 2 cubs dead in 1999
206	1994	6	3	2	♀ 505
206	1997			2	♀ 596 dead in 1999, ♀ 592 dead in 2000
538	1997	6	3		1 yearling separated from ♀ 538 in 1998
538	2000		1	2	2 cubs dead in 2000
538	2001		1	2	2 cubs dead in 2001
538	2002			2	2 cubs of unknown sex and fate
303	2000	7	3	2	1 cub dead in 2000, ♀ 552
303	2003		4		At least 2 cubs
303	2007		3		
303	2010			3	1 cub dead in 2010
303	2013				Observed with courting male in May 2014
303	2016				1 yearling observed in 2016
354	2000	5	3		Genetic data indicated reproduction of at least two cubs in 2000
354	2003		3		At least 2 cubs
354	2006				At least 2 cubs
353	2002	7		3	♀ 353 dead in 2002, 3 cubs (1 female) all assumed dead in 2002
772	2003	6	4		Genetic data indicated reproduction of at least one cub in 2003
772	2007			2	♀ 789, ♂ 791
675	2009	7	1	2	2 cubs dead in 2009
675	2010			1	1 cub dead in 2010
552	2011		3	2	♀ 2011049122, ♂ 2011049118
552	2014			3	3 cubs, 2 males and one of unknown sex
784	2013	7			At least 2 cubs
784	2018				At least one cub
810	2010	7	4		At least one cub
810	2014			2	2 cubs observed at camera site, August 2014
810	2018			2	2 cubs observed June 2018
820	2009	6	4		At least one cub
820	2013			2	2 cubs ♀ 842, ♂ 818, 818 dead in 2015
820	2018		5	2	2 cubs observed July 2018
831	2004	7	3		At least 1 cub
831	2007			2	2 cubs ♂ 799 and ♀ C20072F

Bear	Year	Age at first reproduction	Reproductive Interval[1]	Cubs	Cubs (relationship and fate, if known)
831	2012			3	3 cubs, ♂ 839, ♀ 900933, ♀ 925063
831	2017			3	Photo with 3 cubs July 2017
731	2013	6	3		At least one cub ♂ 17139
731	2016				At least one cub ♀Y29503F
822	2018	5	2	1	one cub ♂ Y38004M. Photo June 2018
822	2020			2	2 cubs observed July
842	2019	6	1	2	2 cubs dead in 2019
842	2020			2	2 cubs observed October

[1]Number of years from birth to subsequent birth.

Population Trend

Approximately 95% of the survival data and 85% of the reproductive data used in population trend calculations came from bears monitored in the Yaak River portion of this population, hence this result is most indicative of that portion of the recovery area. However, only the Kootenai River divides the Cabinet Mountains from the Yaak River and the trend produced from this data would appear to be applicable to the entire population of native bears in the absence of population augmentation. We have no data to suggest that mortality or reproductive rates are different between the Yaak River and the Cabinet Mountains. The Cabinet Mountains portion of the population was estimated to be <15 in 1988 (Kasworm and Manley 1988) and subsequent lack of identification of resident bears through genetic techniques would suggest the population was possibly 5–10. Population augmentation has added 22 bears into this population since 1990 and a mark recapture population estimate from 2012 indicated the population was 22–24 individuals (Kendall *et al*. 2016). These data indicate the Cabinet Mountains population has increased by 2–4 times since 1988, but this increase is largely a product of the augmentation effort with reproduction from that segment.

The estimated finite rate of increase (λ) for 1983–2020 using Booter software with the unpaired litter size and birth interval data option was 1.017 (95% CI=0.935–1.090, Table 15). Finite rate of change over the same period was an annual 1.7% (Caughley 1977). Subadult female survival and adult female survival accounted for most of the uncertainty in λ, with reproductive rate, yearling survival, cub survival, and age at first parturition contributing much smaller amounts. The sample sizes available to calculate population trend are small and yielded wide confidence intervals around our estimate of trend (i.e., λ). The probability that the population was stable or increasing was 67%. Utilizing the entire survival and reproductive data set from 1983–2020 is partially the product of small sample sizes but also produces the effect of smoothing the data over time and results in a more conservative estimate of population trend.

Finite rates of increase calculated for the period 1983–1998 (λ = 1.067) suggested an increasing population (Wakkinen and Kasworm 2004). Lack of mortality in specific sex-age classes limited calculations for many time periods other than those shown here (Fig. 12). Annual survival rates for adult and subadult females were 0.948 and 0.901 respectively, during 1983–1998, and then declined to 0.926 and 0.740 for the period of 1983–2006, respectively. Cumulative lambda calculations reached the lowest point in 2006 (Fig. 12). Human-caused mortality has accounted for much of this decline in annual survival rates and population trend. Improved adult female survival and subadult female survival rates resulted in an improving population trend estimate since 2006. Improving survival by reducing human-caused mortality is crucial for recovery of this population (Proctor *et al*. 2004).

Table 15. Booter unpaired method estimated annual survival rates, age at first parturition, reproductive rates, and population trend of native grizzly bears in the Cabinet–Yaak recovery zone, 1983–2020.

Parameter	Sample size	Estimate (95% CI)	SE	Variance (%)[a]
Adult female survival[b] (S_a)	17 / 50.2[c]	0.925 (0.833–0.985)	0.040	33.7
Subadult female survival[b] (S_s)	20 / 25.1[c]	0.847 (0.692–0.965)	0.073	51.4
Yearling survival[b] (S_y)	33 / 16.3[c]	0.885 (0.725–1.0)	0.074	2.7
Cub survival[b] (S_c)[d]	46/46	0.652 (0.500–0.783)	0.072	4.6
Age first parturition (a)	14	6.3 (5.9–6.6)	0.186	0.5
Maximum age (w)	Fixed	27		
Unpaired Reproductive rate (m)[e]	16/25/28[f]	0.405360 (0.326–0.536)	0.055	7.1
Unpaired Lambda (λ)	5000 bootstrap runs	1.017 (0.935–1.090)	0.040	

[a] Percent of lambda explained by each parameter
[b]Booter survival calculation which may differ from Kaplan-Meier estimates in Table 13.
[c]individuals / bear-years
[d]Cub survival based on counts of individuals alive and dead
[e]Number of female cubs produced/year/adult female. Sex ratio assumed to be 1:1.
[f]Sample size for individual reproductive adult females / sample size for birth interval / sample size for litter size from Table 14.

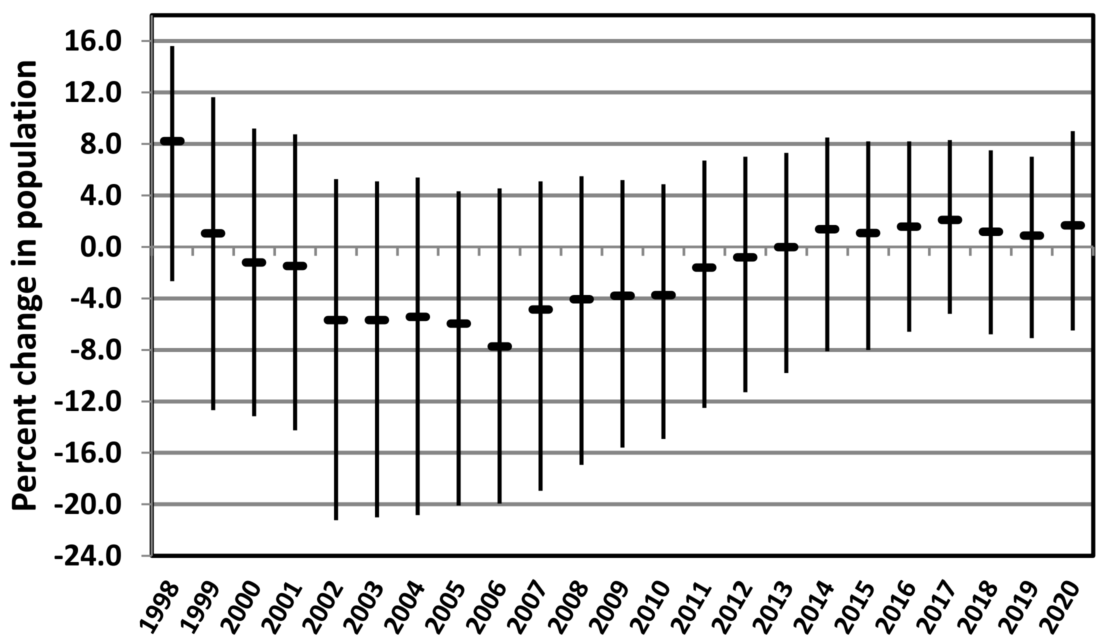

Figure 12. Point estimate and 95% confidence intervals for cumulative annual calculation of population rate of change for native grizzly bears in the Cabinet-Yaak recovery area, 1983–2020. Each entry represents the annual rate of change from 1983 to that date.

Population Estimate

During 2012, USGS used mark-recapture techniques to estimate the CYE grizzly bear population at 48–50 (95% CI = 44–62) (Kendall *et al.* 2016). Using the midpoint of this estimate (49), the calculated rate of increase (1.7%), results in a gain of 7 bears through 2020 to a population of 56. The augmentation program added 8 bears since 2012 but four of those have either left the target area or are known dead. Based on this information, a population estimate of about 60 bears would seem reasonable.

Capture and Marking

Three grizzly bears were captured within the Cabinet and Yaak study area (2 adult females and 1 subadult male) during 2020. All were captured for research monitoring. Ninety-six individual grizzly bears have been captured 148 times as part of this monitoring program since 1983 (Tables 16 and 17). One-hundred twenty-three captures occurred for research purposes and 24 captures occurred for management purposes.

Cabinet Mountains

Research trapping was conducted in the Cabinet Mountains portion of the CYE from 1983–1987. Three adult grizzly bears were captured during this effort (1 female and 2 males). No trapping occurred from 1988–1994 as effort was directed toward the Yaak River. In 1995 an effort was initiated to recapture augmentation bears to determine success of the program and capture any native bears in the Cabinet Mountains. During 1983–2020, 7,715 research trap-nights were expended to capture 13 known individual grizzly bears and 319 individual black bears (Table 16 and 17, Fig. 13). Rates of capture by individual were 1 grizzly bear/593 trap-nights and 1 black bear/24 trap-nights. A trap-night was defined as one site with one or more snares set for one night. One augmentation bear was captured during subsequent trapping efforts

Yaak River, Purcell Mountains South of BC Highway 3

Trapping was conducted in the Yaak portion of the CYE during 1986–1987 as part of a black bear graduate study (Thier 1990). Research trapping was continued from 1989–2020 by USFWS. One-hundred twelve captures of 59 individual grizzly bears and 542 captures of 457 individual black bears were made during 11,738 trap-nights during 1986–2020 (Tables 16 and 17, Fig. 13). Rates of capture by individual were 1 grizzly bear/196 trap-nights and 1 black bear/25 trap-nights. Trapping effort was concentrated in home ranges of known bears during 1995–2020 to recapture adult females with known histories. Much of the effort involved using horses and bicycles in areas inaccessible to vehicles, such as trails and closed roads.

Salish Mountains

Trapping occurred in the Salish Mountains, south of Eureka, Montana, in 2003. An adult female grizzly bear (5 years old), and 5 black bears were captured during 63 trap-nights of effort (Tables 16, 17).

Moyie River and Goat River Valleys North of Highway 3, British Columbia

Eight grizzly bears and 32 black bears were captured in the Moyie and Goat River valleys north of Highway 3 in BC in 2004–2008 (Table 16 and Fig. 13). Trapping was conducted in cooperation with M. Proctor (Birchdale Ecological Consultants, Kaslo, BC) and BC Ministry of Environment. Rates of capture by individual were 1 grizzly bear/32 trap-nights and 1 black bear/8 trap-nights.

Table 16. Research capture effort and success for grizzly bears and black bears within study areas, 1983–2020.

Area / Year(s)	Trap-nights	Grizzly Bear Captures	Black Bear Captures	Trap-nights / Grizzly Bear	Trap-nights / Black Bear
Cabinet Mountains,1983–2020					
Total Captures	7715	16	437	482	18
Individuals[1]	7715	13	319	593	24
Salish Mountains, 2003[1]	63	1	5	63	13
Yaak River South Hwy 3, 1986–20					
Total Captures	11738	112	549	105	21
Individuals[1]	11738	60	463	196	25
Purcells N. Hwy 3, BC 2004–09					
Total Captures	390	10	37	39	11
Individuals[1]	390	9	32	43	12

[1]Only captures of individual bears included. Recaptures are not included in summary.

Table 17. Grizzly bear capture information from the Cabinet-Yaak and Purcell populations, 1983–2020. Multiple captures of a single bear in a single year are not included.

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
678	6/29/83	F	28	86	Bear Cr., MT	Research
680	6/19/84	M	11	(181)	Libby Cr., MT	Research
680	5/12/85	M	12	(181)	Bear Cr., MT	Research
678	6/01/85	F	30	79	Cherry Cr., MT	Research
14	6/19/85	M	27	(159)	Cherry Cr., MT	Research
101	4/30/86	M	(8)	(171)	N Fk 17 Mile Cr., MT	Research
678	5/21/86	F	31	65	Cherry Cr., MT	Research
106	5/23/86	F	8	92	Otis Cr., MT	Research
128	5/10/87	M	4	(114)	Lang Cr., MT	Research
129	5/20/87	F	1	32	Pheasant Cr., MT	Research
106	6/20/87	F	9	(91)	Grizzly Cr., MT	Research
134	6/24/87	M	8	(181)	Otis Cr., MT	Research
129	7/06/89	F	3	(80)	Grizzly Cr., MT	Research
192	10/14/89	M	1	90	Large Cr., MT	Research
193	10/14/89	M	1	79	Large Cr., MT	Research
193	6/03/90	M	2	77	Burnt Cr., MT	Research
206	6/03/90	F	2	70	Burnt Cr., MT	Research
106	9/25/90	F	12	(136)	Burnt Cr., MT	Research
206	5/24/91	F	3	77	Burnt Cr., MT	Research
244	6/17/92	M	6	140	Yaak R., MT	Research
106	9/04/92	F	14	144	Burnt Cr., MT	Research
34	6/26/93	F	(15)	158	Spread Cr., MT	Research
206	10/06/93	F	5	(159)	Pete Cr., MT	Research
505	9/14/94	F	Cub	45	Jungle Cr., MT	Research
302	10/07/94	M	1	95	Cool Cr., MT	Research
303	10/07/94	F	1	113	Cool Cr., MT	Research
106	9/20/95	F	17	(169)	Cool Cr., MT	Research
353	9/20/95	F	Cub	43	Cool Cr., MT	Research
354	9/20/95	F	Cub	47	Cool Cr., MT	Research
302	9/24/95	M	2	113	Cool Cr., MT	Research
342	5/22/96	M	4	(146)	Zulu Cr., MT	Research
363	5/27/96	M	4	(158)	Zulu Cr., MT	Research
303	5/27/96	F	3	(113)	Zulu Cr., MT	Research

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Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
355	9/12/96	M	(6)	(203)	Rampike Cr., MT	Research
358	9/22/96	M	8	(225)	Pete Cr., MT	Research
353	9/23/96	F	1	83	Cool Cr., MT	Research
354	9/23/96	F	1	88	Cool Cr., MT	Research
384	6/12/97	M	7	(248)	Zulu Cr., MT	Research
128	6/15/97	M	14	(270)	Cool Cr., MT	Research
386	6/20/97	M	5	(180)	Zulu Cr., MT	Research
363	6/26/97	M	5	(180)	Cool Cr., MT	Research
538	9/25/97	F	6	(135)	Rampike Cr., MT	Research
354	9/27/97	F	2	99	Burnt Cr., MT	Research
354	8/20/98	F	3	(90)	Cool Cr., MT	Research
106	8/29/98	F	20	(146)	Burnt Cr., MT	Research
363	8/30/98	M	6	(203)	Burnt Cr., MT	Research
342	9/17/98	M	6	(203)	Clay Cr., MT	Research
303	9/21/98	F	5	(113)	Clay Cr., MT	Research
592	8/17/99	F	2	(91)	Pete Cr., MT	Research
596	8/23/99	F	2	(91)	French Cr., MT	Research
358	11/15/99	M	11	279	Yaak R., MT	Management, open freezer, killed goats
538	7/16/00	F	9	(171)	Moyie River, BC	Research
552	7/16/01	F	1	(36)	Copeland Cr., MT	Research
577	5/22/02	F	1	23	Elk Cr., MT	Management, pre-emptive move
578	5/22/02	M	1	23	Elk Cr., MT	Management, pre-emptive move
579	5/22/02	M	1	30	Elk Cr., MT	Management, pre-emptive move
353	6/15/02	F	7	(136)	Burnt Cr., MT	Research
651	9/25/02	M	7	(227)	Spread Cr., MT	Research
787	5/17/03	M	3	71	Deer Cr. ID	Management, garbage feeding
342	5/23/03	M	11	(227)	Burnt Cr., MT	Research
648	8/18/03	F	5	(159)	McGuire Cr., MT, Salish Mtns.	Research
244	9/25/03	M	17	(205)	N Fk Hellroaring Cr., MT	Research
10	6/17/04	F	11	(159)	Irishman C., BC	Research
11	6/20/04	M	7	(205)	Irishman C., BC	Research
12	7/22/04	F	11	(148)	Irishman C., BC	Research
576	10/21/04	M	2	(114)	Young Cr., MT	Management, garbage feeding
675	10/22/04	F	2	100	Young Cr., MT	Management, pre-emptive move
677	5/13/05	M	6	105	Canuck Cr., BC	Research
688	6/13/05	M	3	93	EF Kidd Cr., BC	Research
576	6/17/05	M	3	133	Teepee Cr., BC	Research
690	6/17/05	F	1	52	EF Kidd Cr., BC	Research
17	6/18/05	M	8	175	Norge Pass, BC	Research
2	6/20/05	M	7+	209	EF Kidd Cr., BC	Research
292	7/6/05	F	4	(114)	Mission Cr., ID	Research
694	7/15/05	F	2	73	Kelsey Cr., MT	Research
770	9/20/05	M	11	(250)	Chippewa Cr., MT	Research
M1	10/4/05	M	(2)	(80)	Pipe Cr., MT	Management, garbage feeding
668	10/11/05	M	3	120	Yaak R., MT	Management, garbage feeding
103	5/23/06	M	3	125	Canuck Cr., BC	Research
---	5/28/06	F	4	(125)	Cold Cr., BC (Trap predation)	Research
5381	6/6/06	M	4	(200)	Hellroaring Cr., ID	Research
651	6/28/06	M	11	198	Cold Cr., BC	Research
780	9/22/06	M	6	(250)	S Fk Callahan Cr., MT	Research
130	6/18/07	F	26	113	Arrow Cr., BC	Research
131	6/28/07	F	(5)	(80)	Arrow Cr., BC	Research
784	9/23/07	F	1	(80)	Spread Cr., MT	Research
772	9/18/07	F	10	116	Pilgrim Cr., MT	Management, fruit trees
789	9/18/07	F	Cub	36	Pilgrim Cr., MT	Management, fruit trees
791	9/18/07	M	Cub	39	Pilgrim Cr., MT	Management, fruit trees
785	10/15/07	F	1	75	Pete Cr., MT	Research

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
675	5/23/09	F	7	89	Elmer Cr. BC	Research
784	7/24/09	F	3	(136)	Hensley Cr., MT	Research
731	9/17/09	F	2	(125)	Fowler Cr., MT	Research
5381	11/21/09	M	4	(273)	Kidd Cr., BC	Research
799	5/21/10	M	3	(102)	Rock Cr., MT	Research
737	7/21/10	M	4	129	Messler Cr., MT	Research
1374	8/30/10	M	2	98	Young Cr., MT	Management, garbage feeding
726	5/24/11	M	2	77	Meadow Cr., MT	Research
722	5/31/11	M	12	261	Otis Cr., MT	Research
729	6/18/11	F	1	33	Beulah Cr., MT	Research
724	7/13/11	M	2	159	Graves Cr., MT	Management, killed pigs
732	10/27/11	M	5	139	Otis Cr., MT	Management, killed chickens
729	6/26/12	F	2	(80)	Pipe Cr., MT	Research
737	9/19/12	M	6	(159)	Basin Cr., MT	Research
552	9/24/12	F	12	(136)	Basin Cr., MT	Research
826	6/28/13	M	(5)	(136)	Pipe Cr., MT	Research
303	7/23/13	F	20	132	Pipe Cr., MT	Research
831	6/21/14	F	14	81	Libby Cr., MT	Research
807	6/24/14	M	4	111	Canuck Cr., ID	Research
808	6/27/14	M	4	130	Spruce Cr., ID	Research
722	8/21/14	M	15	(182)	Hellroaring Cr., MT	Research
835	8/24/14	M	19	185	Hellroaring Cr., MT	Research
836	9/19/14	F	1	75	Hellroaring Cr., MT	Research
837	9/29/14	M	6	(227)	Hellroaring Cr., MT	Research
729	5/19/15	F	5	107	Cool Cr., MT	Research
839	6/19/15	M	4	78	Bear Cr., MT	Research
810	7/16/15	F	12	120	Hellroaring Cr., MT	Research
818	7/18/15	M	2	82	Meadow Cr., MT	Research
820	8/20/15	F	12	149	Hellroaring Cr., MT	Research
726	10/5/15	M	6	227	Libby Cr., MT	Management, beehives
836	7/18/16	F	3	87	Hellroaring Cr., MT	Research
822	8/15/16	F	3	92	Hellroaring Cr., MT	Research
824	8/18/16	M	(12)	197	Hellroaring Cr., MT	Research
9811	8/19/16	M	(2)	(91)	Hellroaring Cr., MT	Research
821	8/27/16	M	2	127	Hellroaring Cr., MT	Research
853	9/21/16	M	5	120	Boulder Cr., MT	Research
722	9/29/16	M	17	238	17 Mile Cr., MT	Management, pigs and chickens
922	10/10/16	M	2	130	Upper Yaak R., MT	Management, chicken feed
726	6/18/17	M	8	(195+)	Beulah Cr., MT	Research
1026	6/21/17	F	2	63	Upper Yaak R., MT	Management, habituated
1028	6/21/17	F	2	64	Upper Yaak R., MT	Management, habituated
861	6/25/17	M	2	55	Bear Cr., MT	Research
840	6/26/17	F	2	53	Cruien Cr., MT	Research
842	7/25/17	F	4	93	Fourth of July Cr., MT	Research
810	9/18/17	F	14	150	Hellroaring Cr., MT	Research
9077	4/30/18	M	(3)	112	Thompson R., MT	Management
927	9/5/18	M	(2)	92	Dry Cr., ID	Management, Black Bear Bait Station
722	9/23/18	M	19	238	Hellroaring Cr., MT	Research
844	6/22/19	M	(3)	122	Pipe Cr, MT	Research
866	6/25/19	M	(3)	134	Bear Cr, MT	Research
835	7/23/19	M	24	175	Canuck Cr, MT	Research
822	7/25/19	F	6	109	Canuck Cr, MT	Research
770	10/11/19	M	25	207	Bear Cr,MT	Management, Livestock feed
930	6/23/20	M	2	78	Whitetail Cr.,MT	Research
784	7/24/20	F	14	115	Hellroaring Cr.,MT	Research
729	9/21/20	F	10	158	Burnt Cr.,MT	Research

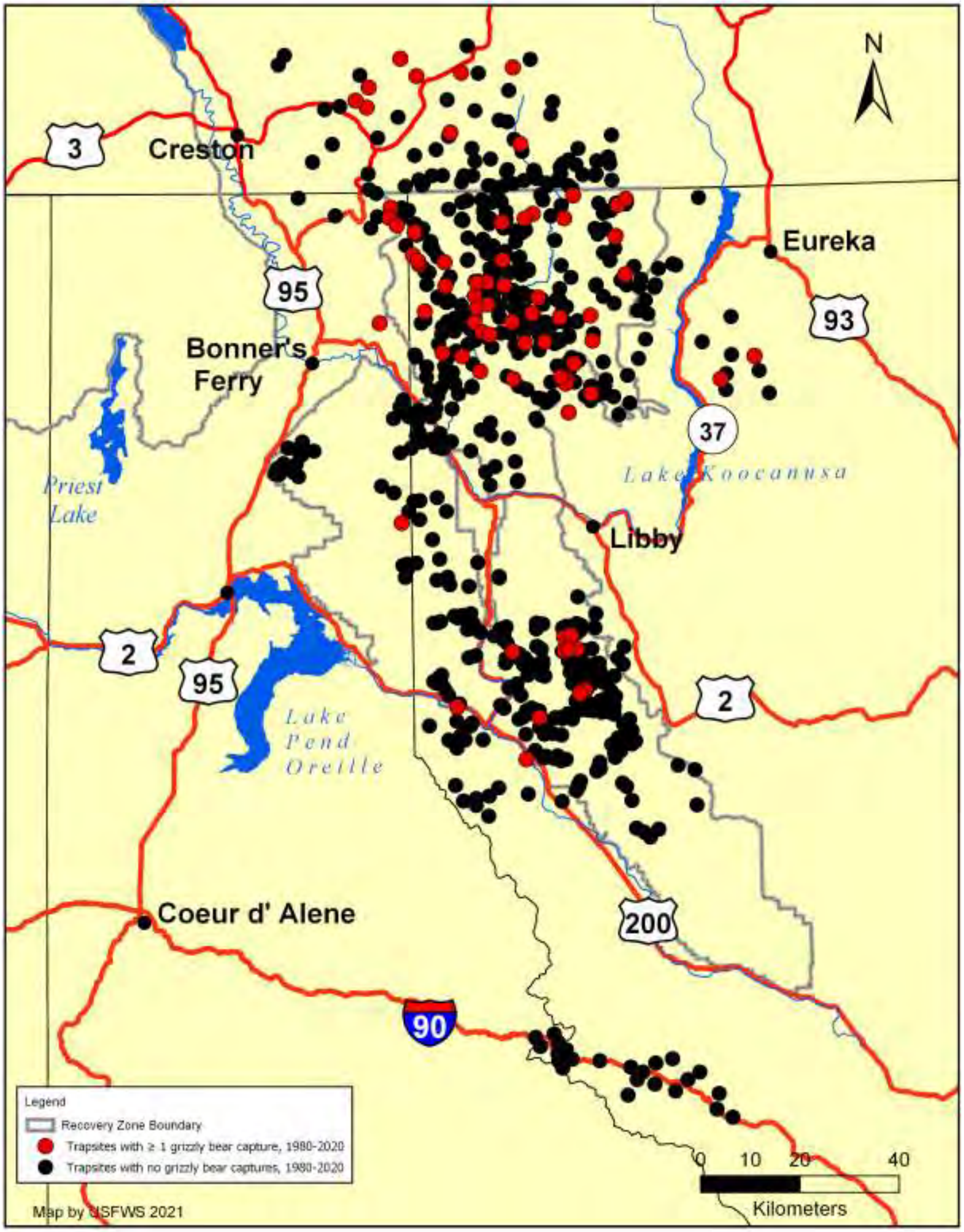

Figure 13. Trap site locations in the Cabinet-Yaak study areas 1983–2020. Red dots represent sites with ≥ one grizzly bear capture.

Grizzly Bear Monitoring and Home Ranges

Ten grizzly bears were monitored with radio-collars during portions of 2020. Research monitoring included three females (two adults and one subadult) and four males (three adult and two subadults) in the CYE. Two subadult males and a subadult female were from the Cabinet Mountains augmentation program. One adult male bear was collared for conflict management purposes.

Aerial telemetry locations and GPS collar locations were used to calculate home ranges. The convex polygon life ranges were computed for bears monitored during 1983–2020 (Table 18 and Appendix 4 Figs. A1-A108). Resident, non-augmentation bears with life range estimates for bears with ≥ 5 months of telemetry were used to calculate basic statistics. Adult male life range averaged 2,105 km^2 (95% CI ± 507, n = 35) and adult female life range averaged 687 km^2 (95% CI ± 186, n = 21) using the minimum convex polygon estimator.

Young female bears typically utilize home ranges adjacent to or a part of their mother's home range. The minimum convex polygon estimator for bear 106 was 852 km^2 during her 1986–1999 lifetime (Fig. 14). Her home range was smallest during the five years that she had cubs. Four known female offspring of bear 106 established home ranges around their maternal range (Fig. 14). Bear 206 has established a home range adjacent to and north of her mother's home range. Bear 303 has established a home range east of her mother's home range and female 354 may have established her home range west of her mothers. Bear 353 lived within her mother's old range, before her death. Second-generation female offspring of 106 occupied habitats east and west of first-generation offspring. In recent years, third-generation females have established home ranges south of second-generation females (Fig. 14).

Home ranges of collared grizzly bears overlap extensively on a yearly and lifetime basis. However, bears typically utilize the same space at different times. Male home ranges overlap several females to increase breeding potential, but males and females consort only during the brief period of courtship and breeding. Adult male bears, whose home ranges overlap, seldom use the same habitat at the same time to avoid conflict.

Table 18. Home range sizes of native (independent or family groups) and transplanted grizzly bears in the Cabinet-Yaak recovery zone, Purcell Mountains and Salish Mountains 1983–2020.

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km^2)	Area of use
678	F	28-34	1983-89	VHF	173	658	Cabinet Mtns, MT
680	M	11-12	1984-85	VHF	75	1,947	Cabinet Mtns, MT
14	M	27	1985	VHF	23	589	Cabinet Mtns, MT
101	M	8	1986	VHF	38	787	Yaak River, MT
106	F	8-20	1986-99	VHF	379	852	Yaak River, MT
128	M	4-14	1987-97	VHF	204	2,895	Yaak River, MT
129	F	1-3	1987-89	VHF	42	60	Yaak River, MT
134	M	8-9	1987-88	VHF	20	594	Yaak River, MT
192	M	2	1990	VHF	10	574	Yaak River, MT
193	M	2	1990	VHF	34	642	Yaak River, MT
206	F	2-7	1990-95	VHF	208	1,332	Yaak River, MT
218[1]	F	5-6	1990-91	VHF	95	541	Cabinet Mtns, MT
244	M	6-18	1992-04	VHF	158	1,406	Yaak River, MT
258[1]	F	6-7	1992-93	VHF	54	400	Cabinet Mtns, MT
286[1]	F	2-3	1993-94	VHF	82	266	Cabinet Mtns, MT
311[1]	F	3-4	1994-95	VHF	16	209	Cabinet Mtns, MT
302	M	1-3	1994-96	VHF	60	514	Yaak River, MT

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km²)	Area of use
303	F	1-22	1994-01, 2011-16	GPS & VHF	12,177	605	Yaak River, MT
342	M	4-12	1996-04	VHF	134	1,653	Yaak River, MT
355	M	(6)	1996	VHF	5	N/A	Yaak River, MT & BC
358	M	8-10	1996-98	VHF	55	1,442	Yaak River, MT & BC
363	M	4-7	1996-99	VHF	120	538	Yaak River, MT
386	M	5-6	1997-98	VHF	29	1,895	Yaak River, MT
354	F	2-4	1997-99	VHF	70	537	Yaak River, MT
538	F	6-11	1997-02	VHF	232	835	Yaak River, MT & BC
592	F	2-3	1999-00	VHF	59	471	Yaak River, MT & BC
596	F	2	1999	VHF	10	283	Yaak River, MT & BC
552	F	1-15	2001, 2012-15	GPS & VHF	1,431	1,210	Yaak River, MT
577	F	1	2002	VHF	11	2	Cabinet Mtns, MT
578	M	1	2002	VHF	3	N/A	Cabinet Mtns, MT
579	M	1	2002	VHF	10	5	Cabinet Mtns, MT
353	F	7	2002	VHF	37	119	Yaak River, MT
651	M	7-11	2002-03,06	GPS & VHF	1,827	1,004	Yaak River, MT & BC
787[2]	M	3-4	2003-04	VHF	84	1,862	Yaak River, MT
648	F	5-7	2003-05	VHF	85	948	Salish Mtns, MT
576[2]	M	3-4	2005-06	GPS & VHF	2,290	1,320	Yaak River, MT & BC
675	F	2-8	2004-10	GPS & VHF	1,827	714	Yaak River, MT & BC
10	F	11	2004	GPS	1,977	176	Moyie River, BC
11	M	7	2004	GPS	894	1,453	Moyie River, BC
12	F	11	2004	GPS	1,612	333	Moyie River, BC
17	M	8	2005	GPS	1,903	3,074	Yaak River, MT & BC
677	M	6	2005	GPS	519	3,361	Yaak River, MT & BC
688	M	3-4	2005-06	GPS	3,421	1,544	Moyie & Goat River, BC
694	F	2	2005	VHF	11	89	Yaak River, MT
292	F	4	2005	GPS	7,062	253	Moyie & Goat River, BC & ID
770	M	11-12,25	2005-06,19	VHF & GPS	1039	524	Cabinet Mtns, MT
2	M	(7-9)	2005-06	GPS	1,337	2,860	Moyie / Yahk, BC
A1[1]	F	(8-10)	2005-07	VHF	73	725	Cabinet Mtns, MT
782[1]	F	2-5	2006-08	GPS	1,126	1,932	Cabinet Mtns, MT
780	M	6-8	2006-08	VHF	56	1,374	Cabinet Mtns, MT
103	M	2-4	2006-07	GPS	4,872	6,545	Kootenai, & Pend Oreille River, BC, ID, & WA
5381	M	4-5	2006-07	GPS	11,491	1,949	Moyie & Goat River, BC & ID
130	F	26-27	2007-08	GPS	3,986	281	Goat River, BC
131	F	(5)	2007-08	GPS	3,270	276	Goat River, BC
784	F	1-3,16	2007-09,20	GPS	2311	611	Yaak River, MT
785	F	1-2	2007-08	GPS	362	207	Yaak River, MT
772	F	10	2007	VHF	14	446	Cabinet Mtns, MT
635[1]	F	4	2008	GPS	285	451	Cabinet Mtns, MT
790[1]	F	3	2008	GPS	227	423	Cabinet Mtns, MT
715[1]	F	(10-11)	2009-10	GPS	437	6,666	Cabinet Mtns, MT
731	F	2-4	2009-11	GPS	1,652	852	Yaak River, MT
799	M	2-4	2010-11	GPS	1,422	805	Cabinet Mtns, MT
713[1]	M	5-6	2010-11	GPS & VHF	562	5,999	Cabinet Mtns, MT
714[1]	F	5-6	2010-12	GPS	1,684	2,389	Cabinet Mtns & Flathead, MT
737	M	4-7	2010-13	GPS & VHF	1,626	2,667	Yaak River, MT & BC
1374	M	2	2010	GPS	14	381	Yaak River, MT & BC
722[2]	M	12-19	2011-19	GPS	3523	4,282	Yaak River, MT & BC
723[1]	M	1-3	2011-12	GPS	430	1,063	Cabinet Mtns, MT

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km²)	Area of use
724[2]	M	1-3	2011-12	VHF	29	873	Cabinet Mtns, MT
725[1]	F	2-4	2011-13	GPS	3,194	3,314	Cabinet Mtns & Flathead, MT
726	M	2-3,6-8	2011-12,15-17	GPS	6,335	3,751	Kootenai & Yaak River, MT
729	F	1-7,10	2011-13, 15-17,20	GPS	17,952	560	Yaak River, MT
732[2]	M	5	2011	GPS	875	458	Yaak River, MT
918[1]	M	2-4	2012-14	GPS	1,192	587	Cabinet Mtns, MT
826	M	-5	2013	GPS	164	1,820	Yaak& Kootenai River, MT & BC
919[1]	M	4-5	2013-14	GPS	792	2974	Cabinet Mtns, MT
808	M	4-5	2014-15	GPS	1,273	1,722	Yaak River, MT
831	F	14	2014	GPS	434	218	Cabinet Mtns, MT
835	M	12-14,17-18	2014-16,19-20	GPS	3361	4,4298	Yaak River, MT
836	F	1-4	2014--17	GPS	3,772	1,816	Yaak River, MT
837	M	6-8	2014-16	GPS	1,173	1,553	Yaak River, MT
920[1]	F	3-5	2014-16	GPS	5,108	913	Cabinet Mtns, MT
921[1]	F	2-3	2014-15	GPS	2,033	259	Cabinet Mtns, MT
810	F	12,14-15	2015,2017-18	GPS	3,150	413	Yaak River, MT
818	M	2	2015	GPS	461	225	Yaak River, MT
839	M	3-4	2015-16	GPS & VHF	2,595	6,819	Cabinet & Whitefish Mtns, MT
820	F	12-14	2015-18	GPS	2,537	295	Yaak River, MT
924[1]	M	2	2015	GPS	741	2,068	Cabinet Mtns, MT
1001	M	6	2015	GPS	1,352	1,357	Selkirk Mtns, BC
807	M	4-7	2014-17	GPS	2,568	3,319	Selkirk Mtns, ID&Yaak River, MT
821	M	2-3	2016-17	GPS	2,467	4,405	Yaak River, MT
822	F	3,6-7	2016,19-20	GPS	2930	1144	Yaak River, MT
824	M	(12-13)	2016-14	GPS	455	884	Yaak River, MT & BC
853	M	5-6	2016-17	GPS	938	736	Kootenay River, BC
9811	M	(2-4)	2016-18	GPS	3,135	1,210	Moyie River, MT,ID,BC
922[2]	M	4-5	2016-17	GPS	938	2,148	Kootenai Rr., ID Yaak Rr, MT
926[1]	M	4-5	2016-17	GPS	2,834	3,328	Cabinet Mtns, MT
840	F	2-4	2017-19	GPS	2987	627	Pipe Cr., MT
842	F	4-6	2017-19	GPS	2776	753	Yaak River, MT
861	M	2-4	2017-19	GPS	2,376	669	Cabinet Mtns, MT
1026[2]	F	2	2017	GPS	3,435	1,556	Creston Valley, BC Yaak Rr., MT
1028[2]	F	2	2017	GPS	1,639	708	Yaak Rr.,MT St. Mary's Rr. ,BC
927[1]	M	2-4	2018-20	GPS	9011	29583	Cabinet & Bitterroot Mtns, MT, ID
9077[2]	M	(3)	2018	GPS	193	1,155	Cabinet Mtns, Yaak River, MT
1006	M	2-3	2017-18	GPS	1,921	8,092	Selkirk & Cabinet Mtns, Yaak River MT
844	M	4-5)	2019-20	GPS	4082	5448	Yaak and Kootenai Rr.,MT
866	M	4-5	2019-20	GPS	3038	3758	Salish & Cabinet Mtns, MT
892[1]	M	(3)	2019-20	GPS	1845	5127	Cabinet Mtns ID, MT & Kootenai Rv., MT
923[1]	F	2	2019-20	GPS	1781	681	Cabinet Mtns ID & MT
930	M	2	2020	GPS	1004	583	Yaak River, MT

[1]Augmentation bears.

[2]Management bears.

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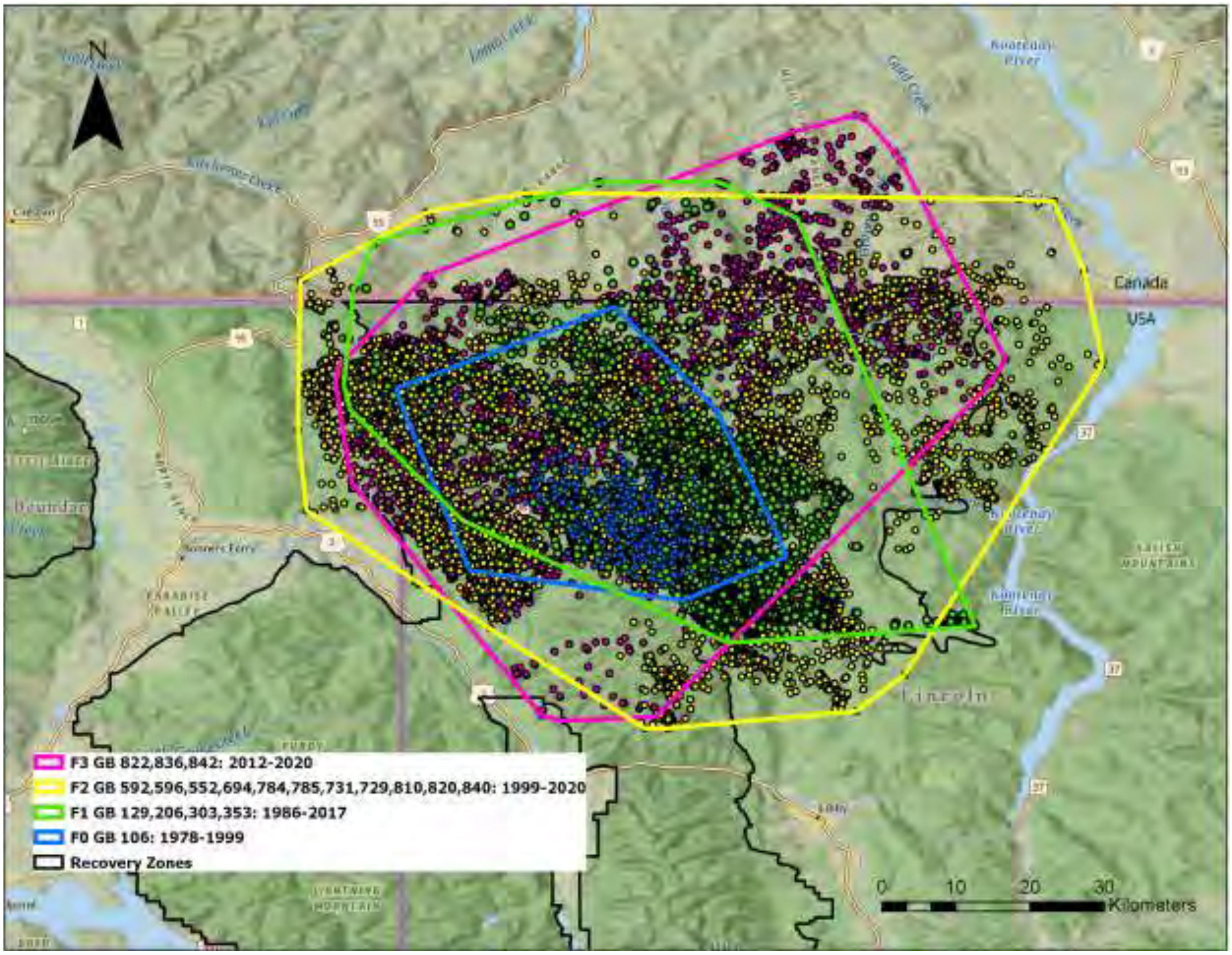

Figure 14. Generational home ranges of female grizzly bears in the Yaak River descended from bear 106, 1986–2020.

Grizzly Bear Denning Chronology

We summarized den entry and exit dates of radio-collared grizzly bears using primarily VHF and GPS location data (1983–2020). Radio-collars deployed since the late 2000s include an activity monitoring device (i.e., accelerometer), which allows an additional, more detailed assessment of den entrance and exit and activity during the denning period.

Den entry dates (n = 129) ranged from the third week of October to the last week of December. Ninety-five percent (122) of entries occurred between the 4th week of October and the 3rd week of December (Fig. 15). Grizzly bears in the Cabinet Mountains (median entry in 2nd week of November) entered dens 2 weeks earlier than bears in the Yaak River drainage (median entry during 4th week of November). Males generally entered dens later than females. Female-offspring family groups tended to enter dens later than independent adult females (Fig. 16). By December 1, 39% of Cabinet and Yaak grizzly bears had not yet entered winter dens (22% females and 61% of males, Fig. 17).

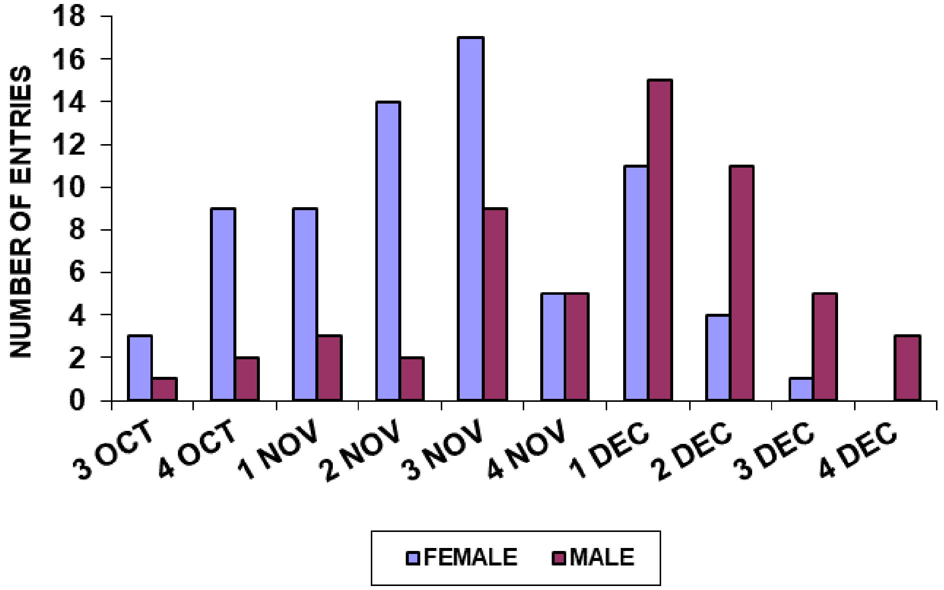

Figure 15. Month and week of den entry for male and female radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2020.

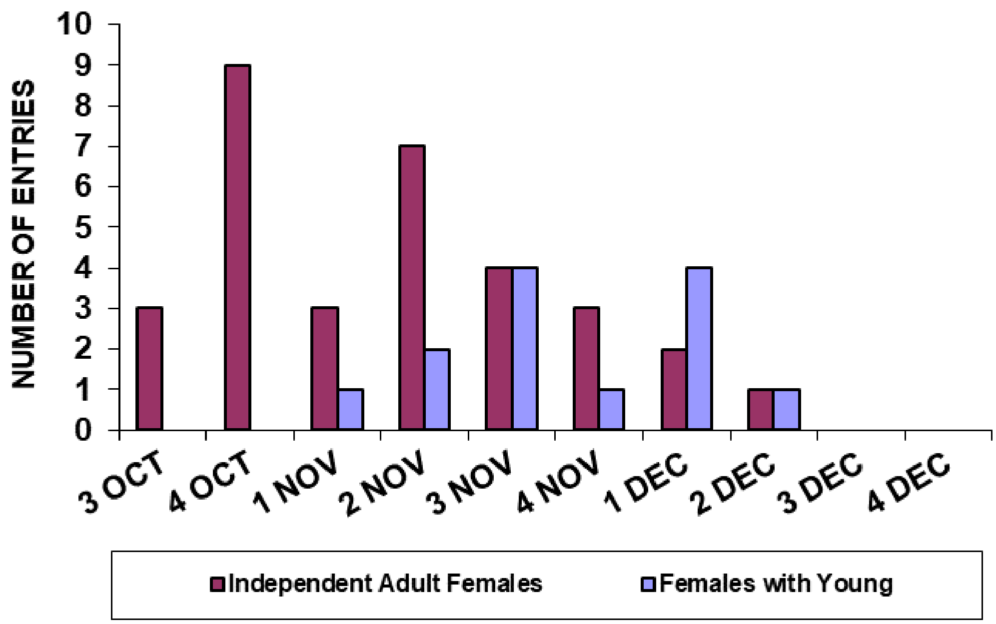

Figure 16. Month and week of den entry for adult female, radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2020.

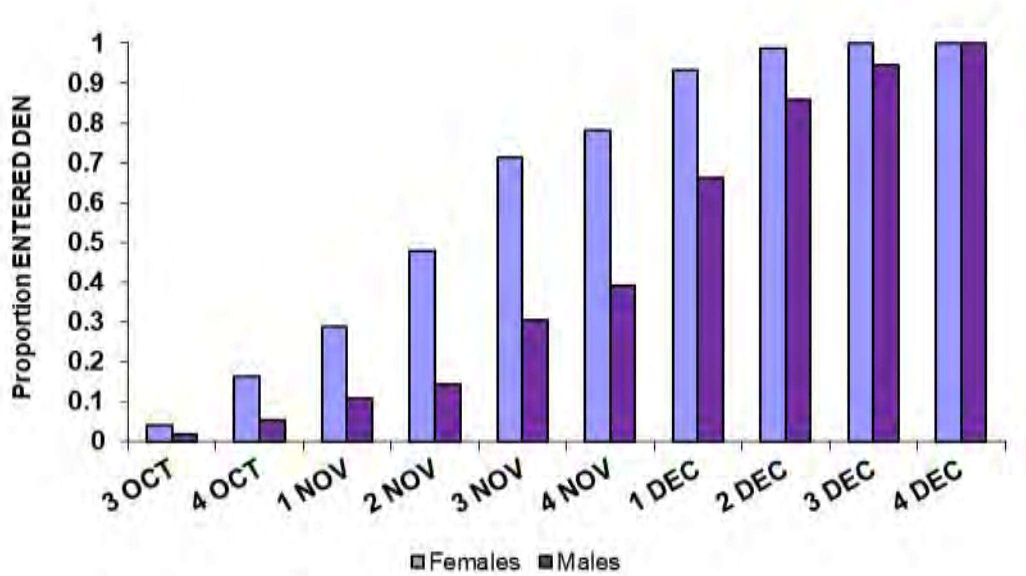

Figure 17. Cumulative proportion of den entries for female and male, radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, by month and week, 1983–2020.

Den exit dates (n = 121) ranged from the first week of March to the third week of May (Fig. 18). Ninety-six percent (116) of exit dates occurred from the 2^{nd} week of March through the 2^{nd} week of May. Grizzly bears in the Cabinet Mountains generally exited dens one week later than bears in the Yaak river drainage. Males tended to exit dens two weeks earlier than females. Sixty-nine percent of den exits occurred during the month of April. By May 1, 13% of Cabinet and Yaak grizzly bears were still in dens, well over half of which were females with cubs. Females with cubs generally exit dens later than other adult females (median exit during 1^{st} week of May; Fig. 19). All adult females with cubs remained at dens until at least April 15.

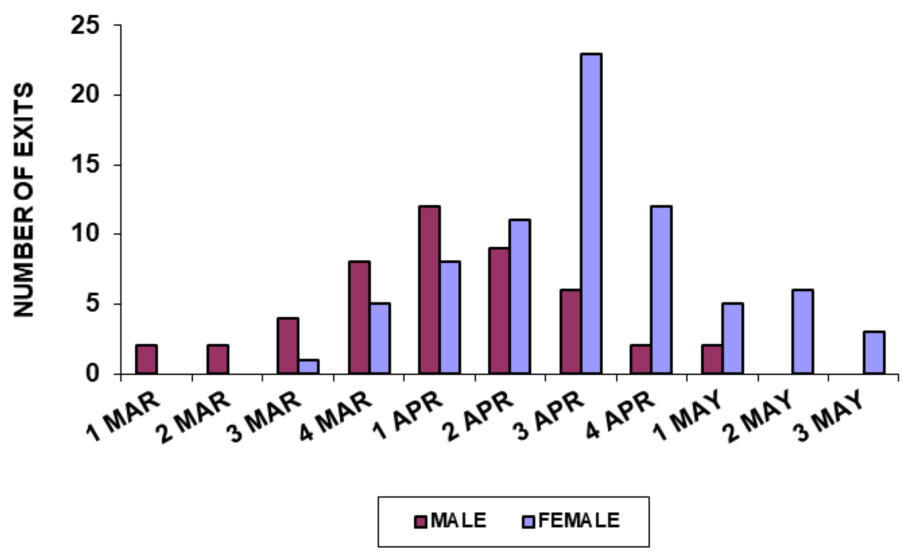

Figure 18. Month and week of den exit for male and female radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2020.

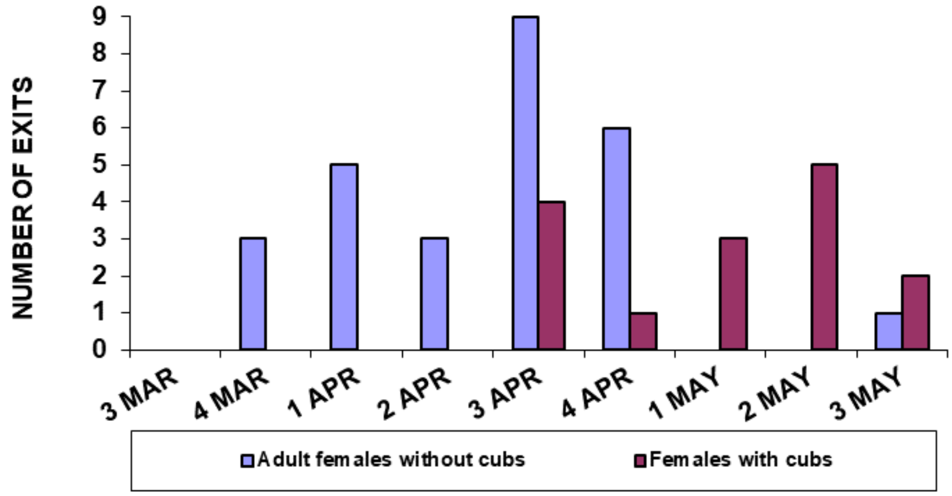

Figure 19. Month and week of den exit for adult female, radio-collared grizzly bears (with and without cubs) in the Cabinet-Yaak grizzly bear recovery zone, 1983–2020.

Grizzly Bear Habitat Analysis

Resource selection functions were utilized to develop seasonal habitat use maps for the Cabinet-Yaak and Selkirk Mountains recovery area zones and surrounding area based on telemetry locations collected from 2004–2015. See Appendix 5 for methodology and maps. The following habitat analysis will discuss both recovery areas.

Grizzly Bear Use by Elevation

Differences in elevation between the Cabinet-Yaak and Selkirk Mountains are reflected in individual bear's radio location data (GPS &VHF) from both areas. To account for differences in sample size between VHF and GPS collared bears, monthly mean elevation for each bear was first calculated. These means were then averaged. Only bears with at least four locations per month were utilized. Grizzly bears in all three study areas exhibited the same general pattern of elevation use (Figure 20). In spring, bears are at lower elevations accessing early green vegetation. As the year progresses, bears move to higher elevations to utilize a variety of berry species. Yaak River bear's decrease in elevation during October and November correspond to the Montana general hunting season. Bears may be utilizing wounded animals and gut piles. Selkirk bears do show an increase in meat consumption later in the year, but by the first week of November 50% of bears have entered dens and may not have the ability to respond to the presence of this protein source. The difference in Idaho and Montana's hunt season structure may account for some of the differences in fall elevation use.

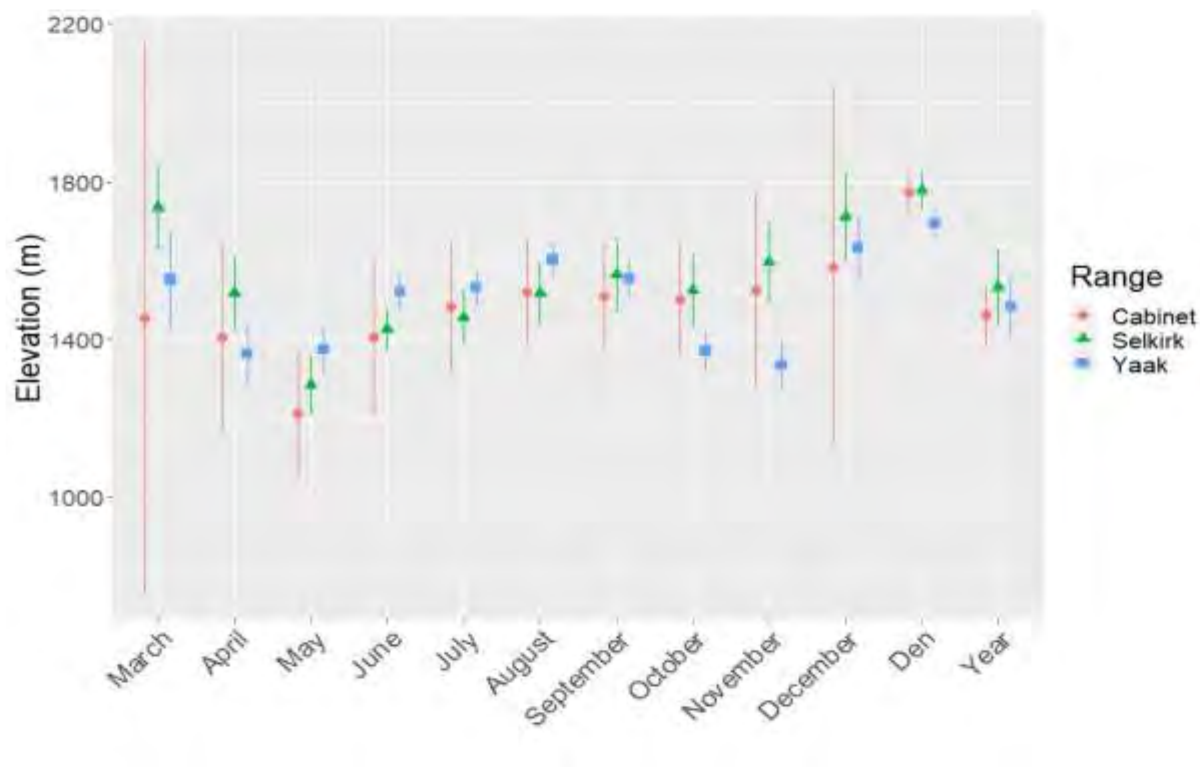

Figure 20. Mean monthly use of elevation for bears in the Cabinet Mountains (*n* = 9) from 1983–2020, the Yaak River (*n* = 58) from 1986–2020, and the Selkirk Mountains (*n* = 93) from 1986–2020 for VHF and GPS collared bears. Error bars represent 95% CI.

Grizzly Bear Use by Aspect

Annual grizzly bear VHF and GPS location summary indicates that Cabinet bears (*n* = 9,801) utilize north facing slopes more so than bears in other study areas (Figure 21). Bears in the Yaak River (*n* = 121,676) and Selkirk (*n* = 84,640) exhibit similar use of aspect, using east the most and north the least.

Bear dens in the Yaak River (*n* = 97) and Selkirk study area (*n* = 93) occurred on east facing slopes more than other aspects (Figure 22). Yaak River bear dens occurred on north slopes more than other study areas. Cabinet bear dens (*n* = 40) utilized east and south facing slopes to the same degree and north facing slopes the least. These differences may be a result of varying topography among study areas and where snowpack is present.

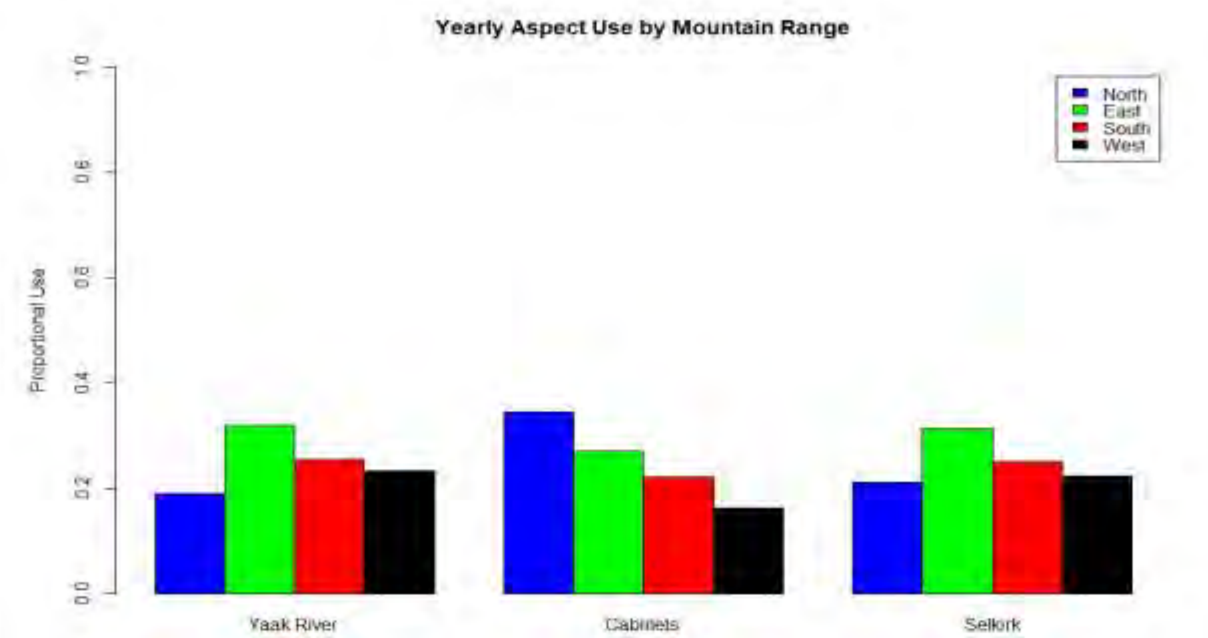

Figure 21. Yearly proportional use of aspect for grizzly bear VHF and GPS locations in the Yaak River from 1986–2020, the Cabinet Mountains from 1986–2020, and the Selkirk Mountains from 1986–2020.

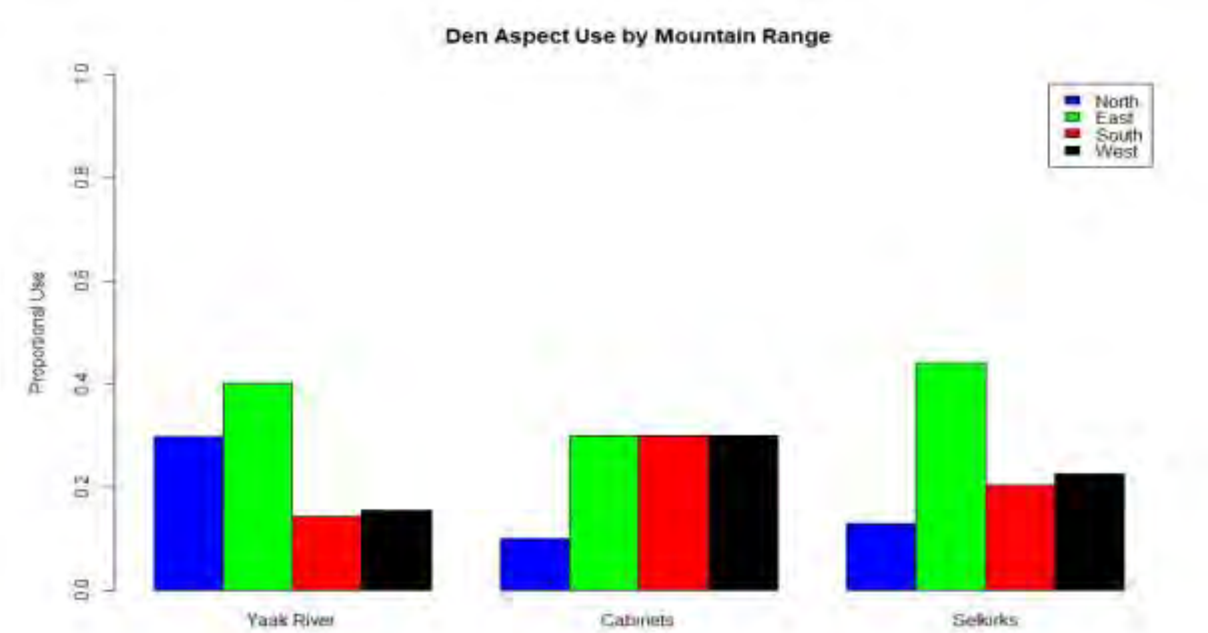

Figure 23. Aspect of grizzly bear dens in the Yaak River from 1986–2020, the Cabinet Mountains from 1983–2020, and the Selkirk Mountains from 1986–2020.

Grizzly Bear Spring Habitat Description

After den emergence in spring, bears seek sites that melt snow early and produce green vegetation. These sites can often overlap with ungulate winter range and provide winterkill carrion. Spring habitat use in both study areas (April and May) indicated use of low elevation

sites. Cabinet Mountain radio locations indicated most use below 1,600 m with primary use of southerly facing snow chutes, alder shrub fields, grassy sidehill parks, and closed timber. Yaak River radio locations indicated most use below 1,400 m with primary use of closed timber, timbered shrub fields, cutting units, and grassy sidehill parks on virtually all aspects. Lower elevation of the Yaak River area may allow snow to melt and vegetation to green-up earlier.

Inter-ecosystem Isotope Analysis

We are using isotope analysis to compare grizzly bear food use (plant vs. animal matter) between ecosystems, among sex-age classes, and across management status. Samples currently analyzed are only from grizzly bears of known sex and age. The majority of samples come from capture events; future analysis will include samples from known grizzly bears at hair rub and hair corral sites. To date, we have obtained carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios from 237 grizzly bear hair and blood samples between 1984 and 2015 from the CYE and Selkirk ecosystems. Across the Selkirk and CYE ecosystems, adult males consume slightly more animal matter (22%) than adult females (14%) and subadults (13%). Adult females in the Yaak River consume higher proportions of animal matter (22%) than do adult females in the Cabinets (10%) and the Selkirks (6%).

We estimate that 14% of the annual diet of Cabinet Mountain grizzly bears (n =19 hair samples from non-management bears) is derived from animal matter. Adult males had slightly higher $\delta^{15}N$ stable isotope signatures (4.2‰) than adult females (3.1‰), indicating greater use of available animal matter (24% vs. 10% animal matter, respectively).

Yaak grizzly bear diets contained nearly 22% animal matter (n = 84 hair samples). Adult female use of animal matter varied widely; $\delta^{15}N$ and diet values ranged as low as 2.3‰ (~6% animal matter) to as high as 7.2‰ (~80% animal matter).

Sampled grizzly bears in the Selkirk ecosystem consumed less animal matter than Cabinet and Yaak bears (12%; n =36 hair samples). Diets of non-management, adult female bears include only 7% animal matter. However, one adult female captured in a management incident in the Creston Valley fed on animal matter at a rate of 82%. We suspect bears such as her likely gain meat from bone piles or dead livestock at nearby dairy operations.

Across ecosystems, management bears had slightly higher proportions of meat (26%) in assimilated diets than research bears (17%). Management bears did not necessarily have higher $\delta^{13}C$ signatures as would indicate a more corn-based or anthropogenic food source (-23‰ for both research and management bears). In fact, highest $\delta^{13}C$ in our dataset came from a research female caught in Corn Creek of the Creston Valley, BC in 2008. By all indications, she likely fed extensively on corn from nearby fields without human conflict.

By analyzing different hair types that initiate growth at different times of the year, we have observed increases in proportion of animal matter in bear diets as they transition from summer months (diet estimated from guard hairs) to fall months (diet from underfur). Previous studies have emphasized the importance of splitting these hair types due to temporal differences in growing period (Jones *et al*. 2006). We currently have 45 bear capture events with paired guard hair and underfur samples collected at capture. In all cases, grizzly bears have either 1) the same dietary meat proportion in summer vs. fall or 2) have higher amounts of meat in their fall diet. On average, grizzly bears meat consumption nearly doubles from summer to fall (10.7% summer to 17.6% fall). Fall shifts toward meat use were not isolated to a specific sex-age class. Larger shifts include: an adult male (4327) shifting from 31% meat in summer to 82% meat in fall, an adult female (mortality 5/18/2012) consuming 14% in spring, then 38% in the fall, and a subadult female grizzly (675) with a summer diet consisting of 6% meat and fall diet of 16% meat. We suspect that wounding loss and gut piles from hunted ungulates contribute to observed increases in meat use by grizzly bears in fall months.

Food Habits from Scat Analysis

Grizzly bear scats (*n* =180) were collected in the Cabinet Mountains between 1981 and 1992. Graminoids (grasses and sedges) were consumed frequently (43% of scats) by grizzly bears in May. Additionally, meat, presumably from winter-killed deer and moose, accounted for 40% of all dry matter consumed in April and May (Fig. 24). In June, the use of forbs increased markedly, yet grasses and sedges were still a dominant food category. Cow parsnip (*Heracleum lanatum*), clover (*Trifolium spp.*), and dandelion (*Taraxacum officinale*) were commonly used in June; over half (52%) of scats in June included parts of at least one of these three forbs. By July, forbs (mainly *Heracleum*) comprised 32% of dry matter consumed by grizzly bears. Only 8% of dry matter consumed in July came from grasses and sedges; graminoids begin to cure in July and provide far less digestible nutrition. Grizzly bears began to feed upon berries (huckleberry and whortleberry [*Vaccinium spp.*], serviceberry [*Amelanchier alnifolia*]) and insects (mainly ants) in July. Food habits during August and September were dominated by use of berries (*Vaccinium* spp., in particular), yet September habits include an increased use of animal matter. Unlike black bears, grizzly bears targeted animal matter (deer, elk, moose) in October. We suspect hunter-discarded gut piles or other remains account for a fair amount of the available animal meat. Fall regrowth of forbs (mainly clover) and graminoids contributed 25% of dry matter consumed by sampled grizzly bears in October. Mammal and berries (i.e., the most calorie-dense foods available) in fall constitute 64% of total dry matter consumed annually by grizzly bears.

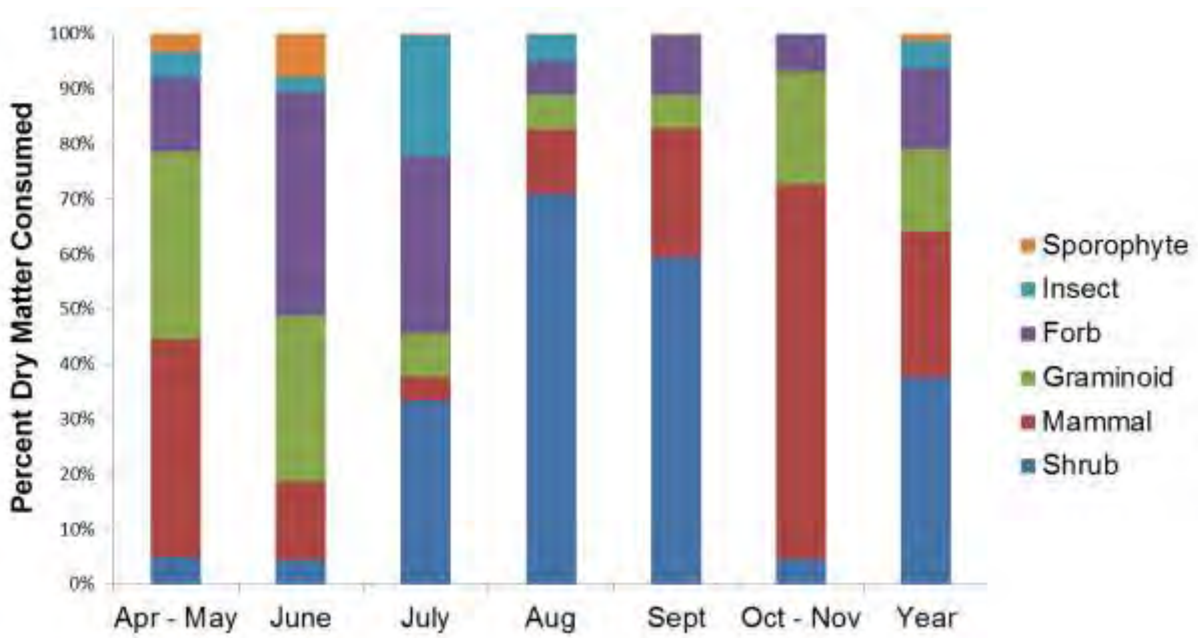

Figure 24. Monthly percent of total dry matter of foods consumed by grizzly bears in the Cabinet Mountains and Yaak River, 1981–1992.

Black bear scats (*n* =618) were collected between 1984 and 1992. Relative use of foods was quite similar to that of grizzly bears between April and August (Fig. 25). However, black bear food habits in September and October were quite different from grizzly bears. Black bears tend to use berries (*Vaccinium* spp., *Sorbus* spp. [mountain-ash], *Amelanchier alnifolia,* and *Arctostaphylos* spp. [bear berry]) more frequently as fall progresses (percent dry matter consumed, August = 74%; September = 82%; October = 91%). In October, black bears fed heavily on mountain-ash. In contrast, grizzly bears increase relative dry matter consumption of

animal meat in fall months (August = 12%, September = 24%; October = 68%). We suggest this difference in food use may be explained by either 1) early den entrance dates for black bears (i.e., den entrance before open of big game hunting season), 2) higher energetic demand of larger grizzly bears (i.e., consumption of calorie-dense foods is metabolically preferred by larger bears; Welch *et al*. 1997), 3) interspecific exclusion of black bears by grizzly bears (i.e., exploitative competition), and/or 4) differences in risk behavior between the two species. On an annual basis, black bears consumed less high-quality, calorie-dense foods (meat and berries; 42%) relative to lower-quality foods such as graminoids and forbs (46%).

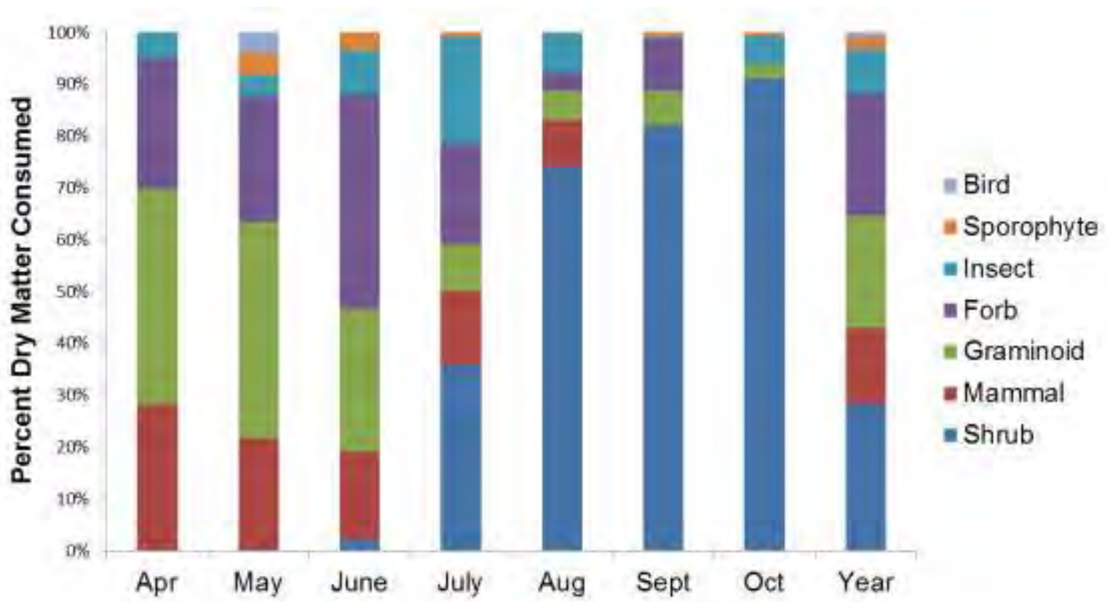

Figure 25. Monthly percent of total dry matter of foods consumed by black bears in the Cabinet Mountains and Yaak River, 1984–1992.

Berry Production

Huckleberry, Buffaloberry, and mountain ash production during 2020 was greater than the long-term average. Serviceberry production was similar to the long-term average. Because of its relatively far-ranging distribution in the CYE and life history of inhabiting larger areas (e.g., shrub fields) when compared with other berry-producing plants, huckleberries appear to provide a greater amount of food for bears in the CYE. However, serviceberry and mountain ash may provide significant secondary food sources in some years when huckleberry crops have failed (e.g., 2001 and 2003). Mountain ash may be particularly valuable to bears in years of low food production because the berries persist and remain on the plants until after frost and leaf drop. Low berry counts for all three of these species would prove most detrimental for bears attempting to store fat for winter denning (e.g., 2002, 2004, and 2015). Because of its sparse distribution, buffalo berries appear to be the least-available berry food for grizzly bears in the CYE. Below-average production among all species surveyed occurred in 1992, 1998–2000, 2002, 2004, and 2015. The 2015 berry season marked the first time we have observed below average counts for all four berry species in one year. Sampling sites for each species were selected to best represent landscape level variation of geography, elevation, aspect, and overstory canopy (Fig. 26).

Fluctuations in berry production in the CYE may be influenced by climatic variables. Holden *et al*. (2012) found huckleberry production in the CYE to be highest in years with cool

springs and high July diurnal temperature ranges. Serviceberry production was also highest in years with cool springs and high winter snowpack. Future changes in climate may influence the availability of these foods to CYE grizzly bears.

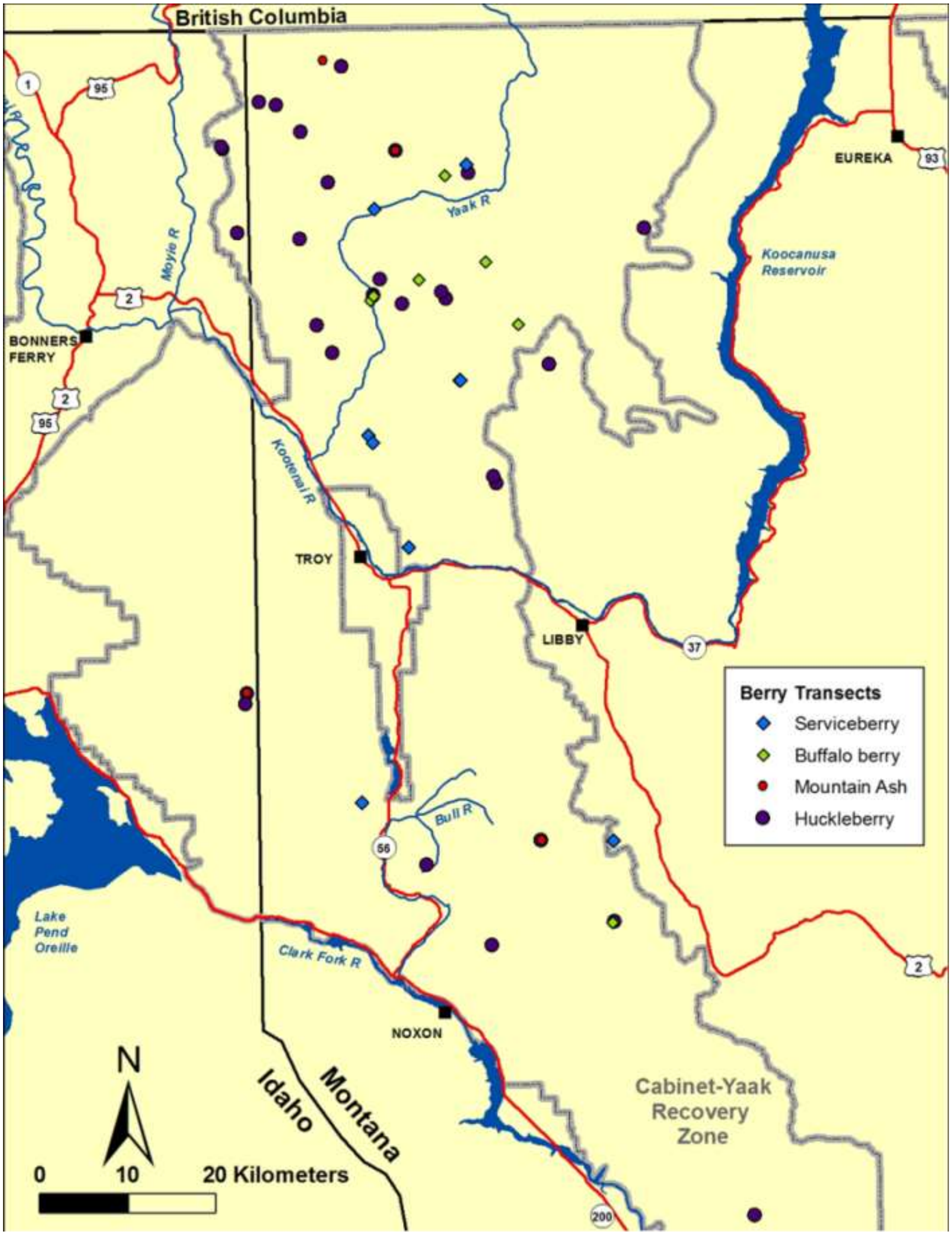

Figure 26. Locations of all serviceberry, buffaloberry, mountain ash, and huckleberry sampling sites within the CYE study area, 1989–2020. Some locations show multiple berry species sites in close proximity.

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Huckleberry

We evaluated berry production at a median number of 18 (range=11–23) huckleberry transects per year within the CYE study area from 1989–2020 (Fig. 27). During this study period, the mean number of berries per plot was 1.8 (95% CI ± 0.12). Mean annual berry counts between 1989 and 2020 ranged from 0.5–3.4. Statistically below-average berry counts occurred in 11 years while above average counts occurred in eight years. Highest mean annual counts occurred in 2014. Based upon these production indices at sampled sites, the 9-year period from 1997–2005 was a prolonged stretch of years without above average annual huckleberry production; more recent mean annual counts since 2006 average 108% higher than during the 1997–2005 period (1.1 berries per plot higher). Of interest is whether lower- and higher-than-average production influences population reproduction and survival.

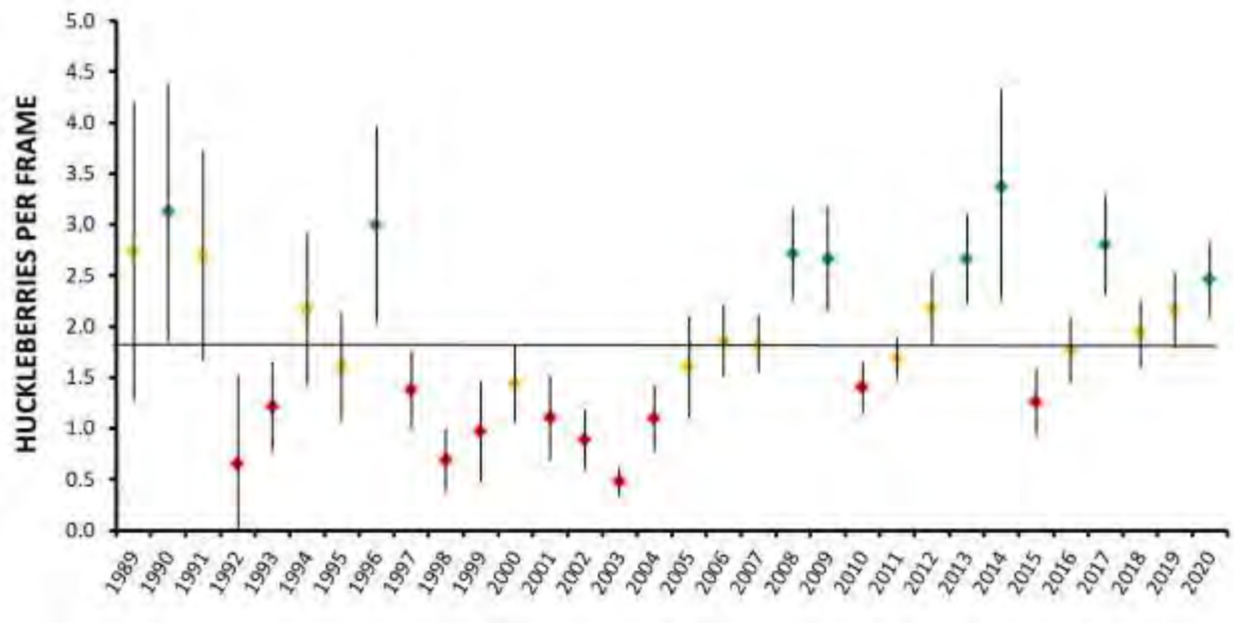

Figure 27. Mean berries per plant (± 95% confidence interval) for huckleberry transects in the Cabinet-Yaak, 1989–2020. Horizontal line indicates study-wide mean production, 1989–2020.

Serviceberry

We evaluated berry production at a median number of six (range = 5–7) serviceberry transects per year from 1990 to 2020 (Fig. 28). The overall mean berry count per plant was 107 (95% CI ± 22) during the study. Mean berry counts per plant ranged from 12 to 355 during the 25+ year index. Statistically below-average counts occurred during 13 years and above average counts occurred only in a single year, 1997. Considering the entirety of the data, the past sixteen years have been particularly less productive (2005–2020; 72 berries per plant) when compared to the first 15 (150 berries per plant from 1990–2004).

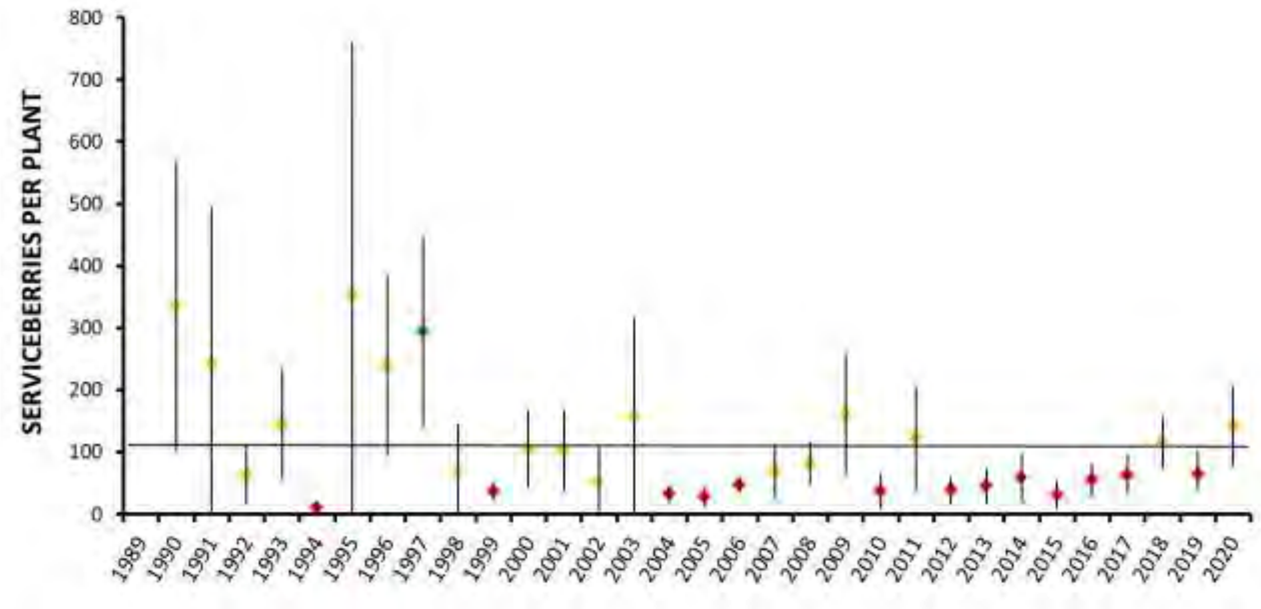

Figure 28. Mean berries per plant (± 95% confidence interval) for serviceberry transects in the Cabinet-Yaak, 1990–2020. Horizontal line indicates study-wide mean production, 1990–20120.

Mountain Ash

Three sites were evaluated for mountain ash production each year, from 2001 to 2020 (Fig. 29). Total mean berry count was 168 berries per plant (95% CI ± 48). Statistically below-average production occurred in six years while above average production occurred in 2 years.

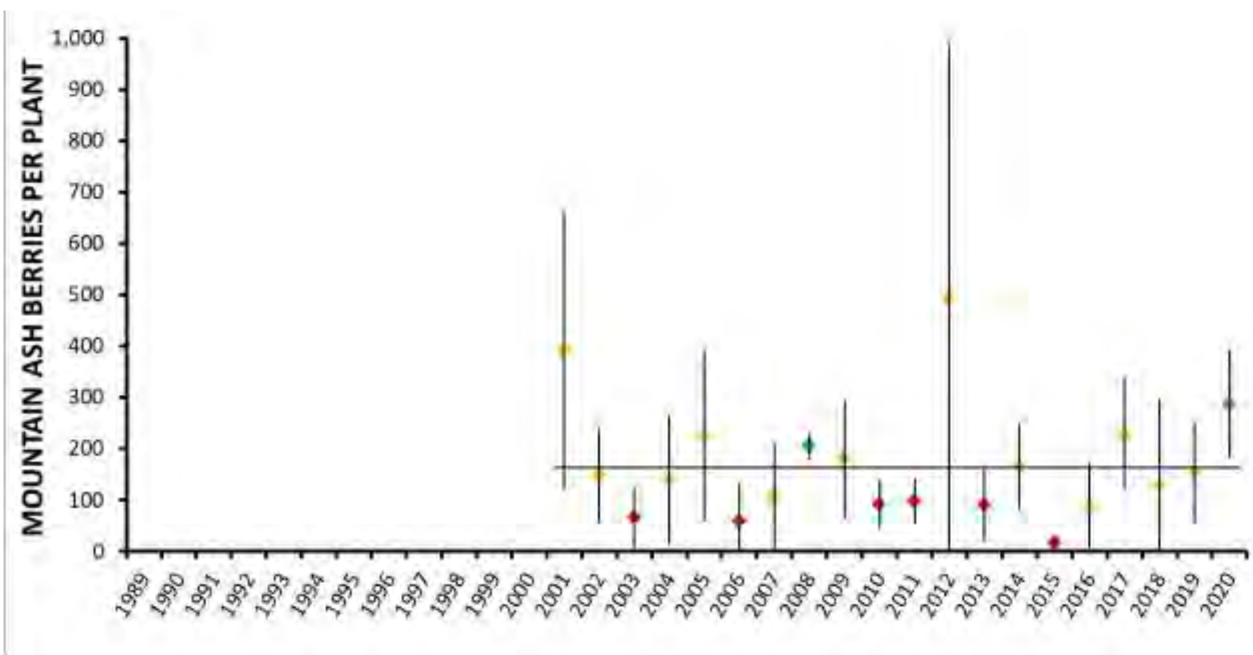

Figure 29. Mean berries per plant (± 95% confidence interval) for mountain ash transects in the Cabinet-Yaak, 2001–2020. Horizontal line indicates study-wide mean production, 2001–2020.

Buffaloberry

Five buffaloberry transects (5 plants at each transect) were evaluated during 1990–1999 and 2002–2003. No sites were sampled during 2004–2006. One new transect (10 plants) was established in 2007 and was the only transect sampled. Another transect (10 plants) was added in 2008. These two transects were evaluated in 2008–2020. A median of 2.5 sites were evaluated annually (range 1–5) between 1990 and 2020. Mean berry count per plant from all transects was 181 (95% CI ± 45) during the study period. Mean berry counts ranged between 15 to 627 berries per plant from 1990 to 2020 (Fig. 30), with statistically below-average counts in nine years and above-average counts occurred in four years.

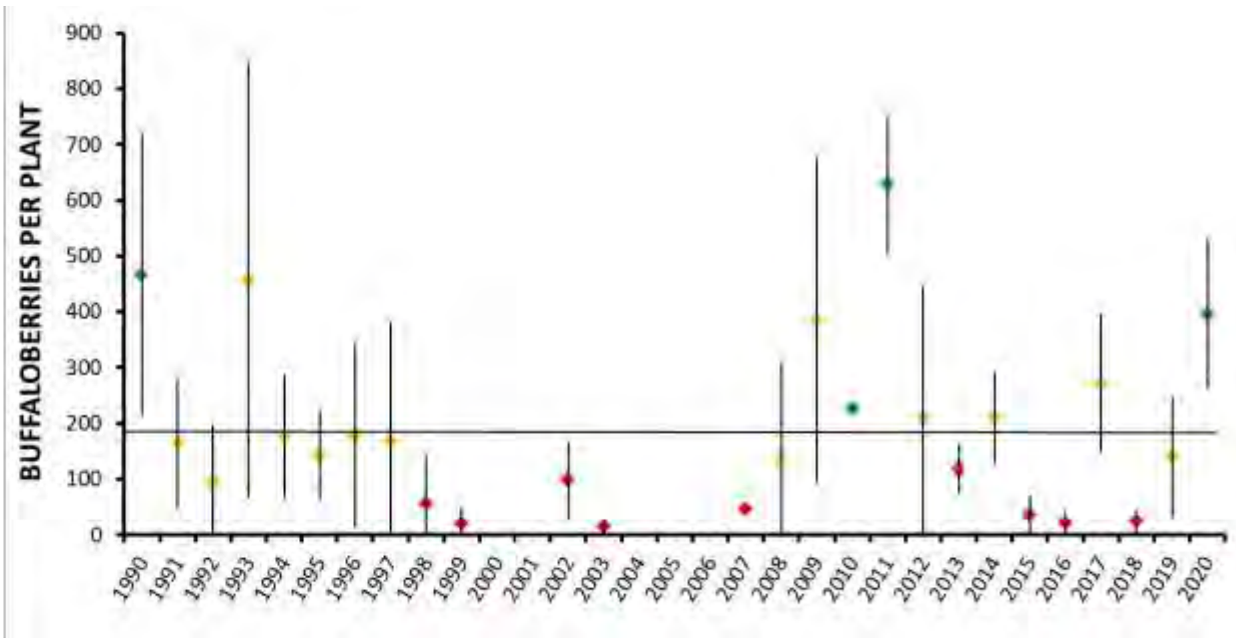

Figure 30. Mean berries per plant (± 95% confidence interval) for buffaloberry transects in the Cabinet-Yaak, 1990–2020. Horizontal line indicates study-wide mean production, 1990–2020.

Body Condition

We estimated body fat content of Cabinet-Yaak and Selkirk (CYS) grizzly bears at 99 independent capture instances, May through November 2010–19. We assessed whether body fat content of CYS grizzly bears differed by sex (56 males, 43 females), capture type (76 research, 23 management captures), and month of capture. Researchers in the Greater Yellowstone and Northern Continental Divide Ecosystems have noted that body fat content of grizzly bears varies by month, exhibiting a trend that is presumably dependent on denning (i.e., inactive) season and availability and quality of foods consumed during the active season (Schwartz *et al*. 2014; Teisberg et al. *in prep*). We similarly partitioned our seasonal data into categorical bins by month, as follows: May (n = 17), June (n = 39), July (n = 16), August (n = 16), and September–November (n = 1).

Body fat content of male and female grizzly bears did not differ (P = 0.077; Table 19). Body fat content of research-captured vs. management-captured grizzly bears also did not differ (P = 0.525; Table 19), suggesting that management bears do not necessarily obtain a more nutritionally rich diet than research-captured bears. However, body fat content of CYS grizzly bears did differ by month (P < 0.0001; Fig. 31). Body fat content in September–November was significantly higher than those in all other months, and August fat contents were higher than

those in June (Tukey-HSD contrasts; $P<0.05$). With all other months, fat content did not differ. CYS grizzly bears appear to start gaining fat as early as July. These results suggest habitat and foods available to CYS grizzly bears allow for body fat gain, such that bears can attain above-average body fat contents in the months preceding den entrance. Reproductive-aged, female grizzly bears experience 1) delayed implantation of already-fertilized eggs in November and 2) cub birth in the den (Jan–Feb). Studies suggest adult females must reach a pre-denning body fat content more than ~20% to support implantation and winter cub production (Robbins et al. 2012).

Table 19. Mean estimates of percent body fat content (kg fat / kg body mass) and effect size (+/- standard error, SE) of Cabinet-Yaak and Selkirk grizzly bears, by factors of interest, 2010–2019.

Factor / Level	Mean	SE
Capture Type		
Research	17.1	+/-0.8
Management	18.1	+/-1.3
Sex		
Female	16.4	+/-1.1
Male	18.8	+/-0.9
Month		
May	17.1	+/-1.6
June	12.7	+/-1.1
July	15.3	+/-1.7
August	18.1	+/-1.6
Sept-Nov	24.7	+/-1.9

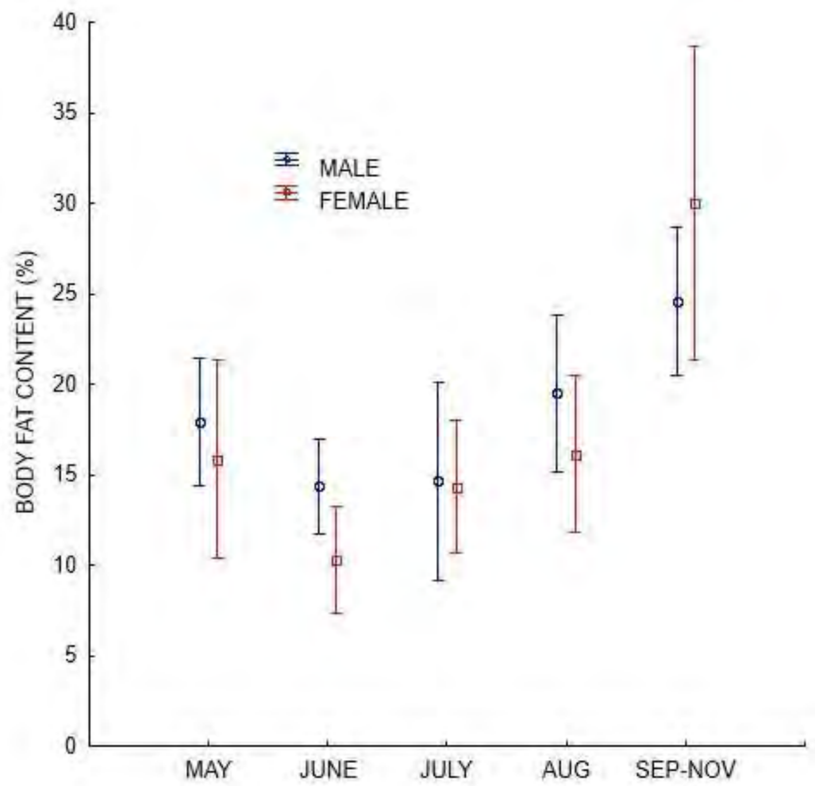

Figure 31. Mean percent body fat content (kg fat / kg body mass) of captured female and male grizzly bears in the Cabinet-Yaak and Selkirk mountains 2010–2019, by month. Error bars represent 95% confidence intervals.

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APPENDIX Table 1. Mortality assignment of augmentation bears removed from one recovery area and released in another target recovery area.

#	Scenario	Where Mortality Credited and Year [1]	
		Source	**Target**
1	Bear stays in Target recovery area[2] past Year 1.	Mortality removal year	No mortality
2	Bear dies in Target recovery area[2] during Year 1.	Mortality removal year	No mortality
3	Bear dies in Target recovery area[2] after Year 1.	Mortality removal year	Mortality, Year 2 or later
4	Bear returns to Source area[2] and dies within Year 1.	Mortality year of death	No mortality
5	Bear returns to Source area[2] and is alive in Year 1.	No mortality	No mortality
6	Bear returns to Source area[2] and is alive after Year 1.	No mortality	No mortality
7	Bear returns to Source area[2] and dies there after Year 1.	Mortality year of death	No mortality
8	Bear dies outside both Target and Source areas[2] within Year 1.	Mortality removal year	No mortality
9	Bear dies outside both Target and Source areas[2] after Year 1.	Mortality removal year	No mortality
10	Collar failure/lost bear in Target area[2] within Year 1.	Mortality removal year	No mortality
11	Collar failure/lost bear in Target area[2] after Year 1.	Mortality removal year	No mortality
12	Collar failure/lost bear outside both Target and Source areas[2] within Year 1.	Mortality removal year	No mortality
13	Collar failure/lost bear outside both Target and Source areas[2] after Year 1.	Mortality removal year	No mortality

[1] Year 1 begins on the day the bear is released in the target area and ends after 365 days. One year was chosen to give the animal an opportunity to locate and use all seasonal habitats. This rule set may conditionally require a bookkeeping correction to remove the mortality in the source area in the year of removal.

[2] Target and Source areas include 10-mile buffer around Recovery Zones. Bears dying in Canada only count against mortality limits in the Selkirk Mountains, where the Recovery Plan defines a Recovery Zone that includes Canada. If an augmentation bear leaves the target recovery area and dies, it counts as source area mortality in the removal year, but it does not count as target area mortality. If an augmentation bear leaves the target recovery area in year 2 or later, it counts as source area mortality in year 1 and target area mortality in year 2 or later if the mortality was human caused. While this approach counts a bear as dead twice, the second mortality represents a human caused mortality issue outside of a bear learning a new area and should be counted in the target area. (Mortalities in Canada only count inside the Selkirk recovery zone inside Canada and the 10-mile buffer will not apply to that portion of the Selkirk recovery area in Canada. Areas adjacent to the Canadian Selkirks have more robust, contiguous populations, several of which are hunted, and mortality should not be counted against the Selkirk recovery area. The 10-mile buffer was promoted inside the US because this area was believed to contain animals that spent a portion of their time outside the recovery area but were believed to be part of that recovery area population.)

APPENDIX Table 2. Known historic grizzly bear mortality pre-dating project monitoring, in or near the Cabinet-Yaak recovery zone and the Yahk grizzly bear population unit in British Columbia, 1949–1978.

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
1949	COPPER CR, MT	1	ADULT FEMALE	HUMAN, LEGAL HUNTER KILL
1950	SQUAW CR, MT	1	SUBADULT	UNKNOWN
1951	PETE CR, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1951	PAPOOSE CR, MT	2	SUBADULTS	UNKNOWN
1951	GOAT CR, MT	1	SUBADULT MALE	UNKNOWN
1952	FELIX CR, MT	6	2 ADULT FEMALES, 4 YEARLINGS	HUMAN, MANAGEMENT REMOVAL
1953	OBRIEN CR, MT	1	SUBADULT MALE	HUMAN, LEGAL HUNTER KILL
1953	KENELTY MT, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1953	20-ODD MT, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1953	BURNT CR, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1953	17-MILE CR, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	N F BULL R, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	S F BULL R, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	TAYLOR PK, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	SILVERBUTTE CR, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	SILVERBOW CR, MT	1	ADULT FEMALE	HUMAN, LEGAL HUNTER KILL
1955	WOLF CR, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1955	MT HEADLEY, MT	1	SUBADULT	HUMAN, MANAGEMENT REMOVAL
1955	BAREE LK, MT	1	ADULT MALE	UNKNOWN
1955	BAREE LK, MT	1	ADULT FEMALE	UNKNOWN
1955	BEAR CR, MT	1	SUBADULT MALE	HUMAN, LEGAL HUNTER KILL
1958	SQUAW CR, MT	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1959	E F ROCK CR, MT	2	ADULT FEMALE, 1 CUB	HUMAN, LEGAL HUNTER KILL
1959	W F THOMPSON R, MT	4	ADULT FEMALE, 3 CUBS	UNKNOWN
1959	CLIFF CR, MT	1	UNKNOWN	UNKNOWN
1960	PROSPECT CR, MT	2	ADULT FEMALE, 1 CUB	UNKNOWN
1964	GRAVES CR, MT	2	SUBADULTS	UNKNOWN
1964	WANLESS LK, MT	3	SUBADULTS (ADULT WOUNDED)	UNKNOWN
1965	SNOWSHOE CR, MT	2	SUBADULTS	UNKNOWN
1965	PINKHAM CR, MT	1	UNKNOWN	UNKNOWN
1967	SOPHIE LK, MT	1	UNKNOWN	UNKNOWN
1968	BEAR CR, MT	1	ADULT FEMALE	HUMAN, ILLEGAL KILL
1968	GRANITE CR, MT	1	SUBADULT MALE	HUMAN, MANAGEMENT REMOVAL
1969	PRISCILLA PK, MT	1	ADULT FEMALE	UNKNOWN
1970	THOMPSON R, MT	1	UNKNOWN	UNKNOWN
1970	CAMERON CR, MT	1	SUBADULT MALE	UNKNOWN
1970	SQUAW CR, MT	2	ADULT FEMALE, SUBADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1971	MURR CR, MT	1	ADULT FEMALE	UNKNOWN
1972	ROCK CR, MT	1	SUBADULT	HUMAN, MISTAKEN IDENTITY (Black Bear)
1974	SWAMP CR, MT	1	ADULT MALE	HUMAN, LEGAL HUNTER KILL
1977	RABBIT CR, MT	1	ADULT MALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1978	MOYIE LAKE, BC	1	SUBADULT MALE	HUMAN, MANAGEMENT

APPENDIX Table 3. Movement and gene flow to or from the Cabinet-Yaak recovery area.

Area[1] Start / Finish	Action	Bear ID	Sex	Age	Year	Basis	Comments
Cabs / NCDE	Movement	C403M	M	2-3	2007	Telemetry, Genetics	Captured Marion, MT 2006 NCDE, traveled to Whitefish, relocated to Whitefish Range. Train kill 2007
NCDE / SPur	Movement	YGB737M	M	4	2010	Genetics	Captured and monitored 2010-15. Parentage in NCDE by USGS.
NCDE / SPur	Movement	43-44	F	3	2013	Capture, Mortality	Management bear relocated at least twice in NCDE. Traveld to SPur, shot after Killing chickens by landowner.
NPur / SPur	Movement	P9183M	M	Unk	2004-05	Genetics	DNA captured NPur and SPur.
NPur / SPur	Movement	PKiddM	M	7	2004	Telemetry	Radio collared June 2004, Travels from NPur to SPur, offspring in SPur.
NPur / SPur	Movement	YMarilF	F	4-5	2005-06	Telemetry, Genetic assignment	Radio collared July 2005 in SPur, Genetic assignment to the NPur. Management removal 2006.
NPur / SPur	Movement	Y732M	M	3	2011	Genetics	Born in NPur and Traveled to SPur. Mortality 2011.
NPur / SPur	Movement	10569F	F	6	2005, 2012	Genetics, Mortality	Father SPur YVernM, Mother NPur PIrishF, DNA capture NPur 2005, Mortality with cub SPur 2012
NPur / SPur	Gene flow	Y90479M	M	0.5	2012	Genetics, Mortality	Father Y576M Mother 10569F Mortality 2012
SPur / NCDE	Movement	N323M	M	Unk	1999	Genetics	Hair snagged 1999 in SPur. Hair snagged NCDE USGS 1998-2006. USGS assigned to SPur.
SPur / Salish	Movement	Y128M	M	18	2001	Mortality	Capture 1987. Monitored 1987-92 and 1997 SPur. Recaptured August 2001 in Salish, Mortality 2001.
SPur / NPur	Movement	Y128M	M	4-14	1987-92, 1997	Telemetry	Capture May 1987 SPur. Monitored 1987-92 and 1997. Monitored NPur and produced offspring.
SPur / NPur	Movement	YVernM	M	7-12	1997, 2002	Telemetry, Genetics	Radio collared SPur 1997. Hair snag NPur 2002.Sired offspring NPur and SPur.
SPur / NPur	Movement	YRockyM	M	8-12	2002-06	Telemetry	Captured and collared SPur 2002. Recapture 2006. Traveled NPur in 2006.
SPur / NPur	Movement	134	M	8-9	1987-88	Telemetry	Radio collar in SPur 1987. Hunter kill 1988 NPur
SPur / NPur	Movement	P9190M	M	4-5	2006-07	Telemetry	Radio collared June 2006 SPur. Traveled to NPur
SPur / NPur	Movement	PTerryM	M	3	2005	Telemetry, Genetics	Father SPS Y178M, Mother SPS Y538F Travel to NPur from SPur.
SPur / SSelK	Movement	YHydeM	M	3	2006-07	Telemetry	Captured in SPur Yaak 2006. Bear traveled to SSelk 2006-07
SPur / SSelK	Gene flow	SOsoM	M	Unk	2009	Genetics	Hair snagged 2001 SPur. Captured SSelk 2009.
SSelk / Cabs / SSelk	Movement	928442	M	5	2012	Genetics	Father SSelk S9058aM, Mother SSelk SBettyF, Hair snagged USGS 2012 Cabs and in SSelk 2015
SSelk / SPur	Movement	S31M	M	6	2004-05	Telemetry, Mortality	Father SSelk SS3KM, Mother SSelk S1MF, Management capture 2003 and Relocated. Hunter kill 2005 SPur
SPur / Cabs / SPur	Movement	Y726M	M	6	2015-16	Telemetry	Travel from SPur to Cabs and back
SPur / SRock	Movement	922947	M	5	2013	Telemetry	Travel north from SPur across Kootenay in BC to SRock and return
SPur / SRock	Movement	928196	M	20	2015-16	Telemetry	Travel north from SPur across Kootenay in BC to SRock and return
SSelk / Cabs	Movement	S1001M	M	6	2015	Telemetry, Mortality	Travel from SSelk to Cabs. Mortality 2015
Cabs / NCDE	Movement	900932	M	4	2015-16	Telemetry	Travel east from Cabs to NCDE

Area[1] Start / Finish	Action	Bear ID	Sex	Age	Year	Basis	Comments
SPur / NPur	Movement	958729	M	12	2016	Telemetry	Travel north from SPur to NPur
SPur / SSelk	Movement	Y11048M	M	4	2017	Telemetry, Mortality	Travel west from SPur to SSelk. Mortality 2017
SPur / SSelk	Movement	YGB807M	M	5	2015-17	Telemetry	Travel west from SPur to SSelk.
SPur / Cabs	Movement	Y821M	M	3	2017	Telemetry	Travel from SPur to Cabs
NPur / SPur	Gene flow	YGB837M	M	6	2014	Genetics	Parents both NPur, Father NPur PKiddM, Mother NPur PIrishF
SPur / NPur	Gene flow	P9194F	F	Unk	2004-05	Genetics	Father SPur Y128M, Mother NPur P9127F, Origin of father probably NPur
NPur / SPur	Gene flow	Y787M	M	3	2003	Genetics	Father SPurYVernM, Mother SPur Y354F, Origin of father probably NPur
NPur / SPur	Gene flow	YU37F	F	1	2001	Genetics	Father SPurYVernM, Mother SPur Y354F, Origin of father probably NPur
SSelk / SPur	Movement	16749	M	Unk	2015	Genetics	Father C134B2V2, Mother JillS226F Both SSelk. Male offspring 16749 SPur
NCDE / Cabs	Movement	C90467M	M	6	2014	Genetics, Mortality	Management bear from NCDE traveled to Cabs, mortality 2014
NCDE / Cabs	Movement	C30604M	M	4	2017	Genetics, Mortality	NCDE Management bear traveled to Cabs 2017 and returned to NCDE mortality 2017
NCDE / Cabs	Movement	C866M	M	3	2019	Genetics	Genetics identified parents in NCDE, captured in Cabinets
NPur / SPur	Movement	P1374M	M	2	2010	Genetics, Mortality	Hair snag as cub in 2008 NPur? Management capture SPur 2010, relocated, Mortality 2010
NPur / SSelk / Cabs / Bitt	Gene flow, Movement	S21285M	M	0.5-2	2016-18	Genetics, Telemetry	Father NPur SCptHM, Mother SSelk S11675F, S21285M traveled to Cabs in 2018, then dropped collar, hair snagged in Bitterroot
SPur / SRock	Movement	18986	M	4	2018	Genetics, Telemetry	Travel north from SPur across Kootenay in BC to SRock (BC mgmt. capture)
NPur / SPur	Movement	Y29761M	M	Unk	2017	Genetics	Father P9101M, Mother PMaeveF, both NPur. Male offspring Y29761M SPur

[1]Cabs – Cabinet Mountains, NCDE – Northern Continental Divide, NPur – Purcell Mountains north of Highway 3, SPur – Purcell Mountains south of Highway 3, SSelk – South Selkirk Mountains south of Nelson, BC

APPENDIX 4. Grizzly Bear Home Ranges

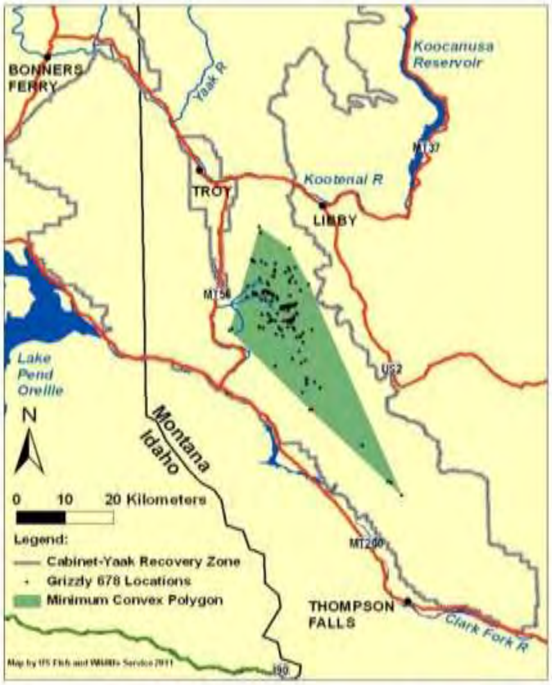

Figure A1. Radio locations and minimum convex (shaded) life range of female grizzly bear 678 in the Cabinet Mountains, 1983–1989.

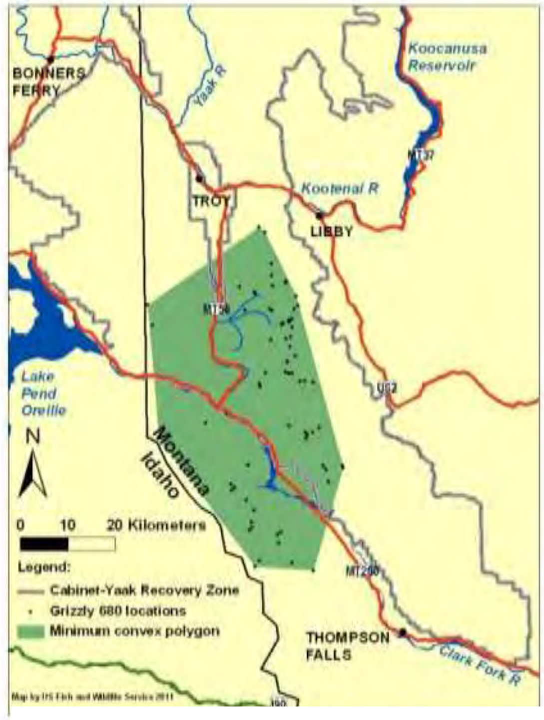

Figure A2. Radio locations and minimum convex (shaded) life range of male grizzly bear 680 in the Cabinet Mountains, 1984–1985.

Figure A3. Radio locations and minimum convex (shaded) life range of male grizzly bear 14 in the Cabinet Mountains, 1985.

Figure A4. Radio locations and minimum convex (shaded) life range of male grizzly bear 101 in the Yaak River, 1986–1987.

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Figure A5. Radio locations and minimum convex (shaded) life range of female grizzly bear 106 in the Yaak River, 1986–1999.

Figure A6. Radio locations and minimum convex (shaded) life range of male grizzly bear 128 in the Yaak River, 1987–1997.

Figure A7. Radio locations and minimum convex (shaded) life range of female grizzly bear 129 in the Yaak River, 1987–1989.

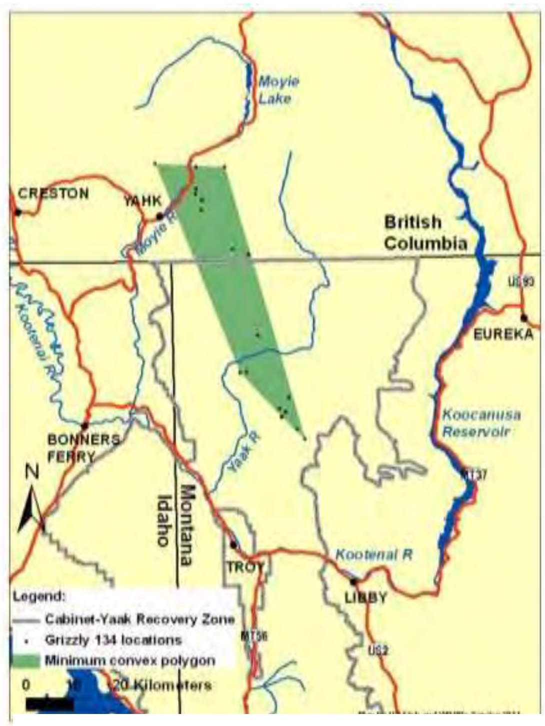

Figure A8. Radio locations and minimum convex (shaded) life range of male grizzly bear 134 in the Yaak River, 1987–1988.

Figure A9. Radio locations and minimum convex (shaded) life range of male grizzly bear 192 in the Yaak River, 1990.

Figure A10. Radio locations and minimum convex (shaded) life range of male grizzly bear 193 in the Yaak River, 1990.

Figure A11. Radio locations and minimum convex (shaded) life range of female grizzly bear 206 in the Yaak River, 1991–1994.

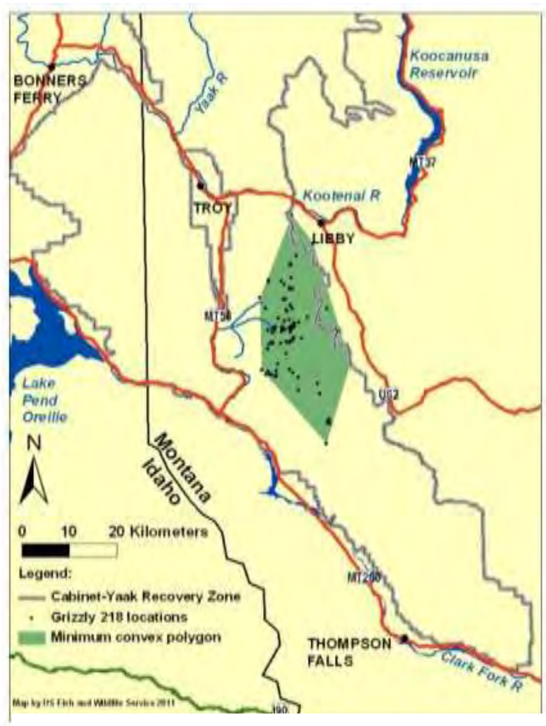

Figure A12. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 218 in the Cabinet Mountains, 1990–1991.

Figure A13. Radio locations and minimum convex (shaded) life range of male grizzly bear 244 in the Yaak River, 1992–2003.

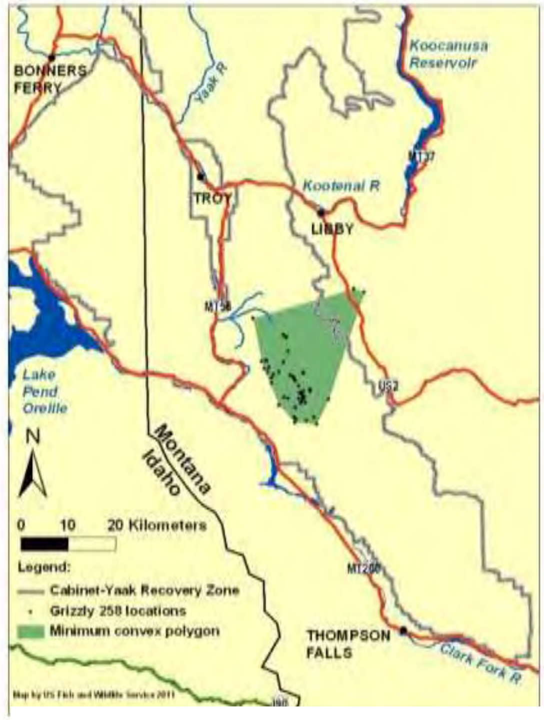

Figure A14. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 258 in the Cabinet Mountains, 1992–1993.

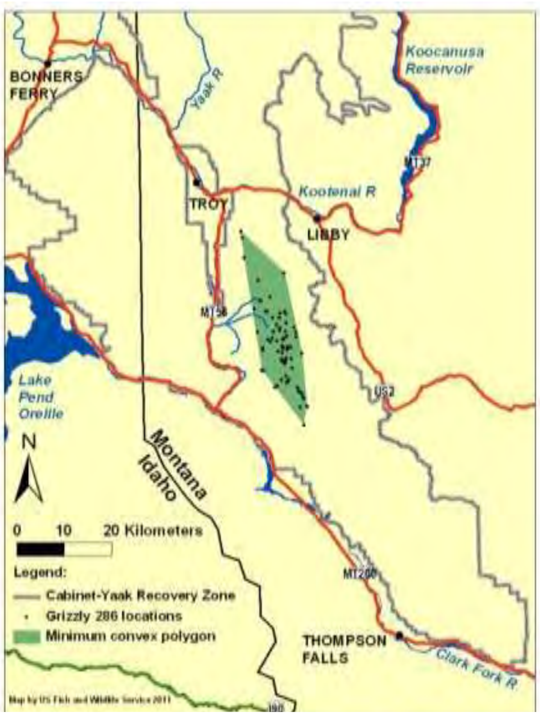

Figure A15. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 286 in the Cabinet Mountains, 1993–1995.

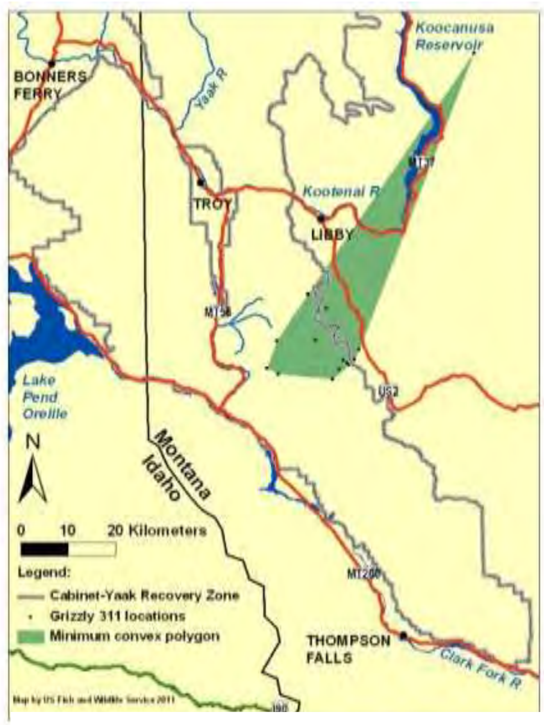

Figure A16. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 311 in the Cabinet Mountains, 1994–1995.

Figure A17. Radio locations and minimum convex (shaded) life range of male grizzly bear 302 in the Yaak River, 1994–1996.

Figure A18. Radio locations and minimum convex (shaded) life range of female grizzly bear 303 in the Yaak River, 1994–2001 and 2011–2016.

Figure A19. Radio locations and minimum convex (shaded) life range of male grizzly bear 342 in the Yaak River, 1995–2001.

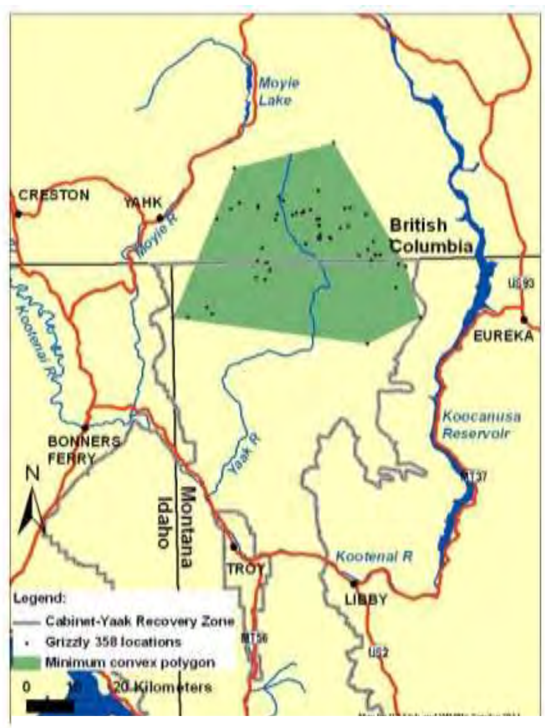

Figure A20. Radio locations and minimum convex (shaded) life range of male grizzly bear 358 in the Yaak River, 1996–1998.

Figure A21. Radio locations and minimum convex (shaded) life range of male grizzly bear 363 in the Yaak River, 1996–1999.

Figure A22. Radio locations and minimum convex (shaded) life range of male grizzly bear 386 in the Yaak River, 1997–1999.

Figure A23. Radio locations and minimum convex (shaded) life range of female grizzly bear 354 in the Yaak River, 1997–1999.

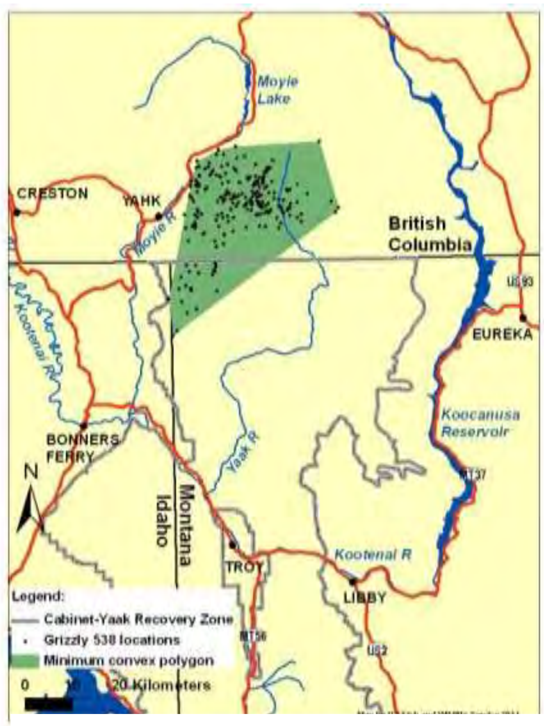

Figure A24. Radio locations and minimum convex (shaded) life range of female grizzly bear 538 in the Yaak River, 1997–2002.

Figure A25. Radio locations and minimum convex (shaded) life range of female grizzly bear 592 in the Yaak River, 1999–2000.

Figure A26. Radio locations and minimum convex (shaded) life range of female grizzly bear 596 in the Yaak River, 1999.

Figure A27. Radio locations and minimum convex (shaded) life range of female grizzly bear 577 in the Cabinet Mountains, 2002.

Figure A28. Radio locations and minimum convex (shaded) life range of male grizzly bear 579 in the Cabinet Mountains, 2002.

Figure A29. Radio locations and minimum convex (shaded) life range of female grizzly bear 353 in the Yaak River, 2002.

Figure A30. Radio locations and minimum convex (shaded) life range of male grizzly bear 651 in the Yaak River, 2002–2006.

Figure A31. Radio locations and minimum convex (shaded) life range of male grizzly bear 787 in the Yaak River, 2003–2004.

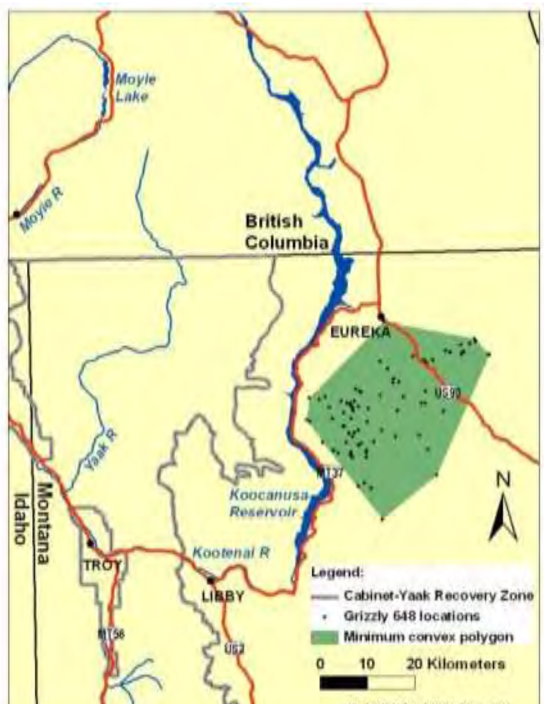

Figure A32. Radio locations and minimum convex (shaded) life range of female grizzly bear 648 in the Salish Mountains, 2003–2005.

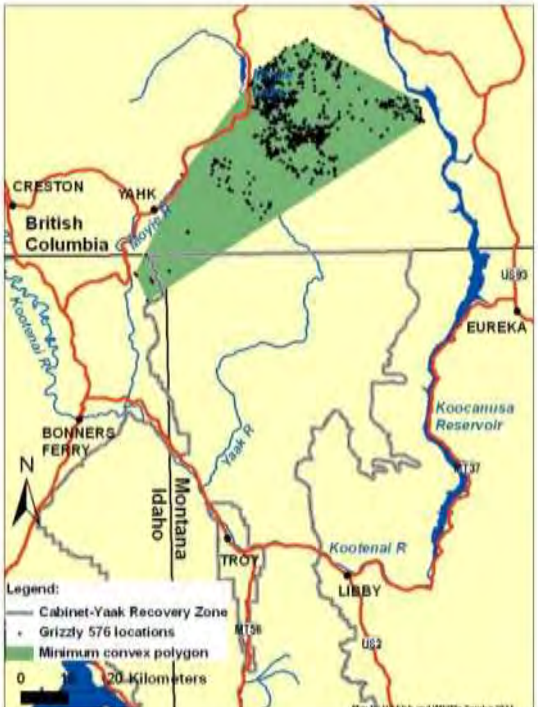

Figure A33. Radio locations and minimum convex (shaded) life range of male grizzly bear 576 in the Yaak River, 2004–2006.

Figure A34. Radio locations and minimum convex (shaded) life range of female grizzly bear 675 in the Yaak River, 2004–2010.

Figure A35. Radio locations and minimum convex (shaded) life range of female grizzly bear 10 in the Purcell Mountains, 2004.

Figure A36. Radio locations and minimum convex (shaded) life range of male grizzly bear 11 in the Purcell Mountains, 2004.

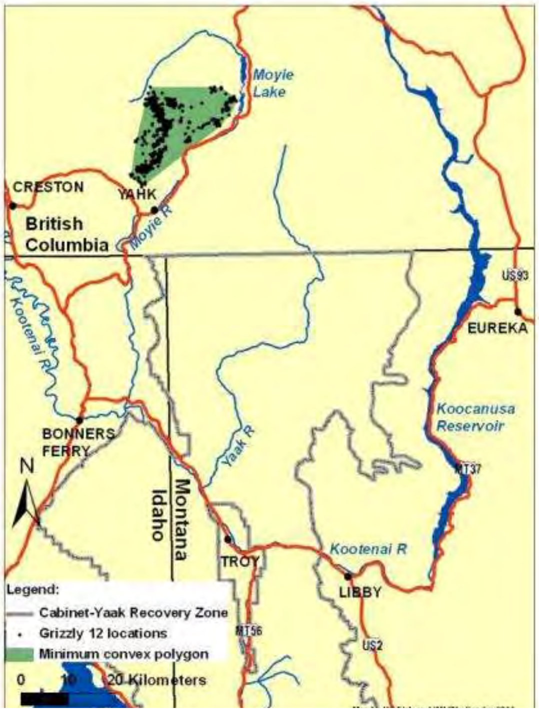

Figure A37. Radio locations and minimum convex (shaded) life range of female grizzly bear 12 in the Purcell Mountains, 2004.

Figure A38. Radio locations and minimum convex (shaded) life range of male grizzly bear 17 in the Purcell Mountains, 2004.

Figure A39. Radio locations and minimum convex (shaded) life range of male grizzly bear 677 in the Purcell Mountains, 2005.

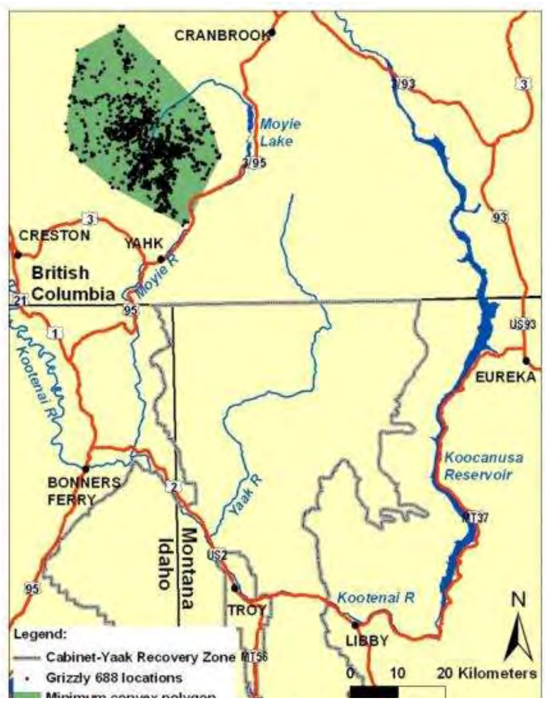

Figure A40. Radio locations and minimum convex (shaded) life range of male grizzly bear 688 in the Purcell Mountains, 2005–2006.

Figure A41. Radio locations and minimum convex (shaded) life range of female grizzly bear 694 in the Yaak River, 2005.

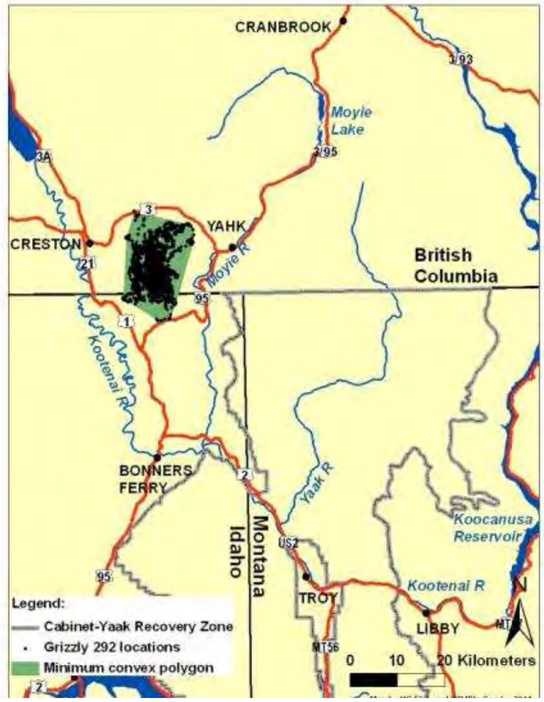

Figure A42. Radio locations and minimum convex (shaded) life range of female grizzly bear 292 in the Purcell Mountains, 2005.

Figure A43. Radio locations and minimum convex (shaded) life range of male grizzly bear 770 in the Cabinet Mountains, 2005–2006, 2019.

Figure A44. Radio locations and minimum convex (shaded) life ranges of male grizzly bear 2 in the Purcell Mountains, 2005.

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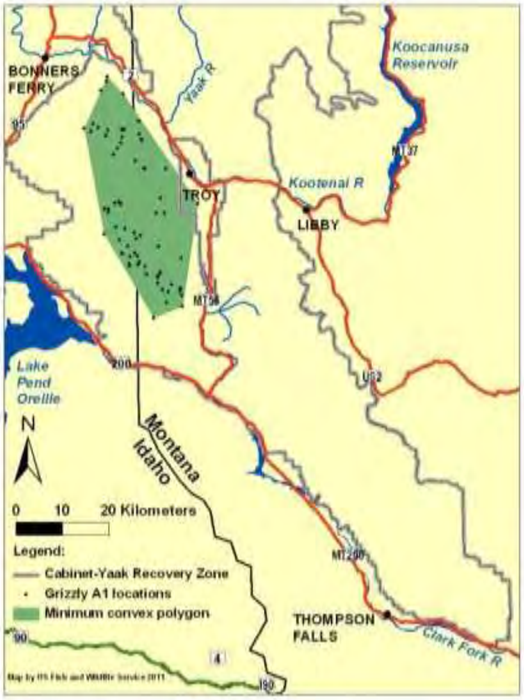

Figure A45. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear A1 in the Cabinet Mountains, 2005–2007.

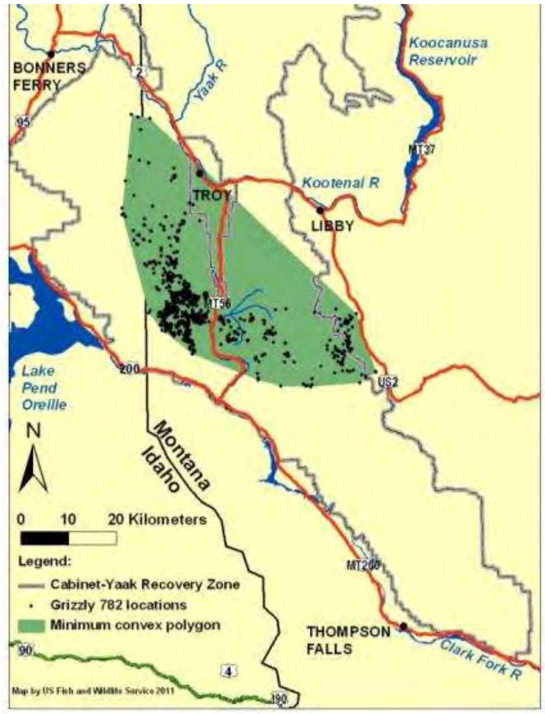

Figure A46. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 782 in the Cabinet Mountains, 2006–2007.

Figure A47. Radio locations and minimum convex (shaded) life range of male grizzly bear 780 in the Cabinet Mountains, 2006–2008.

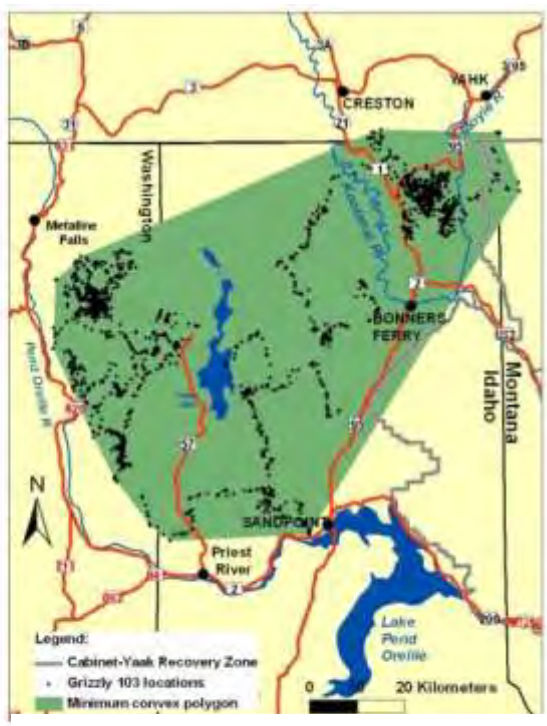

Figure A48. Radio locations and minimum convex (shaded) life range of male grizzly bear 103 in the Yaak River, 2006–2007.

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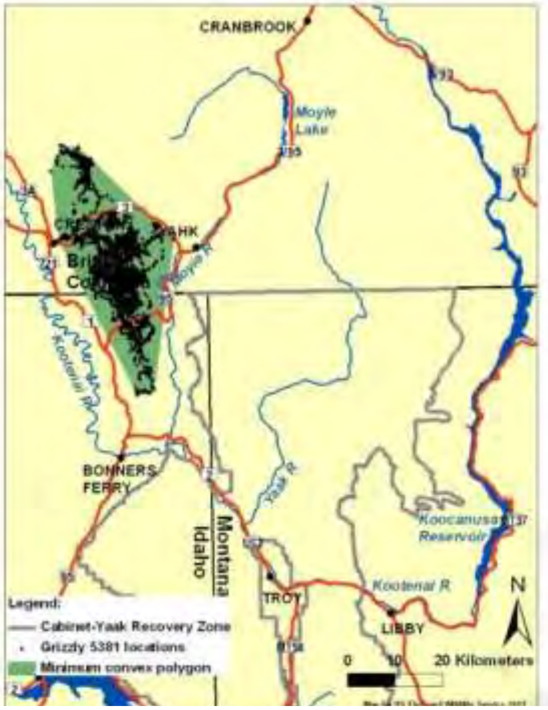

Figure A49. Radio locations and minimum convex (shaded) life range of male grizzly bear 5381 in the Purcell Mountains, 2006–2007.

Figure A50. Radio locations and minimum convex (shaded) life range of female grizzly bear 130 in the Purcell Mountains, 2007–2008.

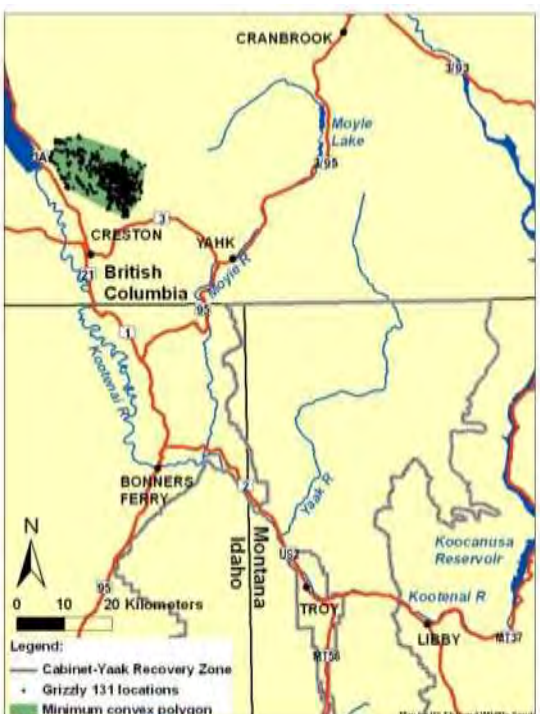

Figure A51. Radio locations and minimum convex (shaded) life range of female grizzly bear 131 in the Purcell Mountains, 2007–2008.

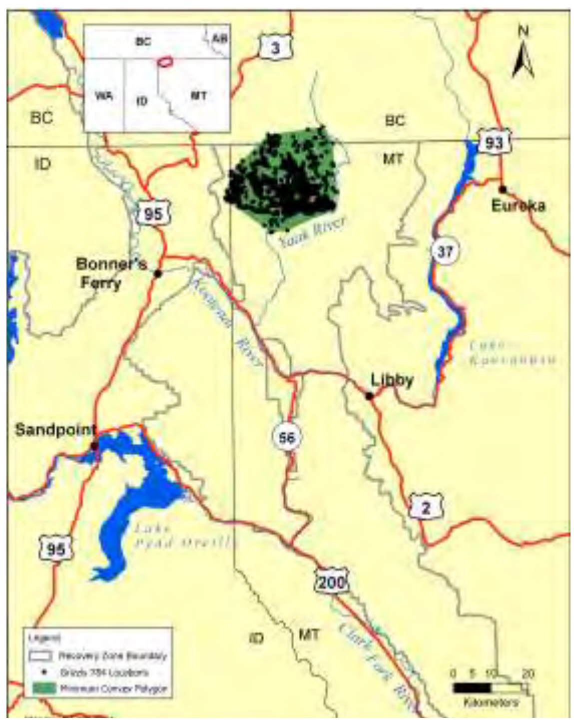

Figure A52. Radio locations and minimum convex (shaded) life range of female grizzly bear 784 in the Yaak River, 2007–2009, 2020.

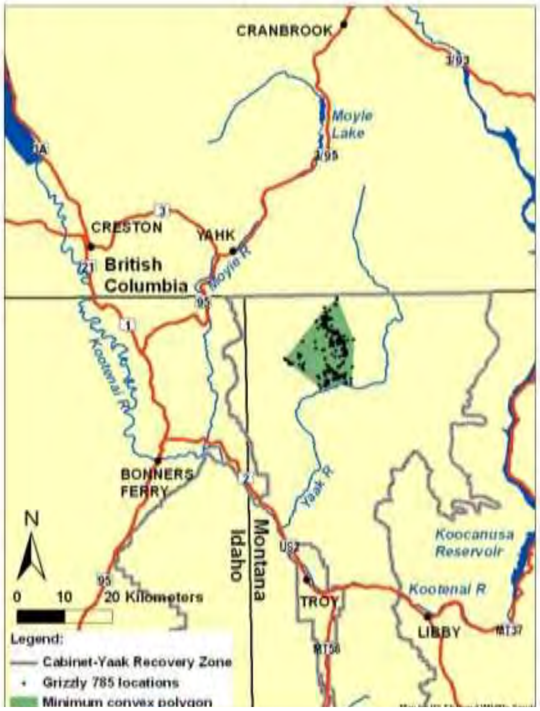

Figure A53. Radio locations and minimum convex (shaded) life range of female grizzly bear 785 in the Yaak River, 2007–2008.

Figure A54. Radio locations and minimum convex (shaded) life range of female grizzly bear 772 in the Cabinet Mountains, 2007.

Figure A55. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 635 in the Cabinet Mountains, 2008.

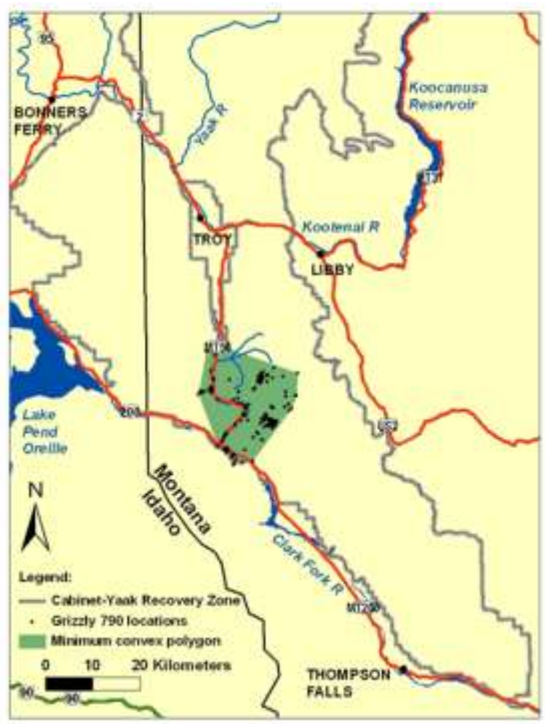

Figure A56. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 790 in the Cabinet Mountains, 2008.

Figure A57. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 715 in the Cabinet Mountains, 2009–2010.

Figure A58. Radio locations and minimum convex (shaded) life range of female grizzly bear 731 in the Yaak River, 2009–2011.

Figure A59. Radio locations and minimum convex (shaded) life range of male grizzly bear 799 in the Cabinet Mountains, 2009–2010.

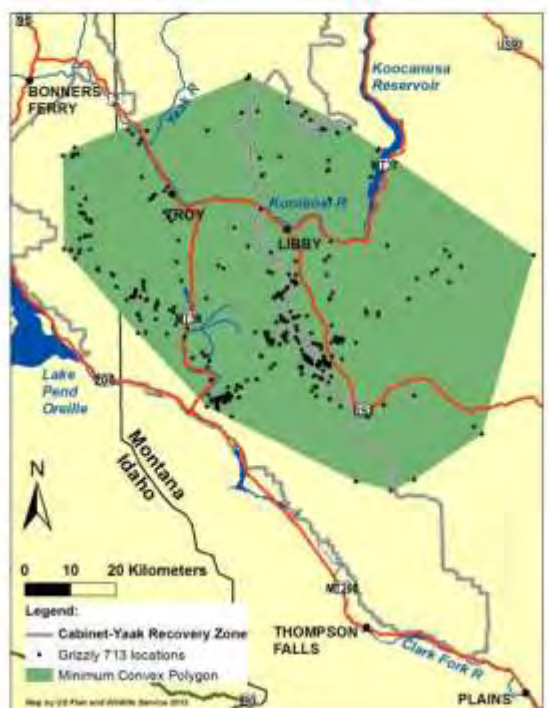

Figure A60. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 713 in the Cabinet Mountains, 2010–2011.

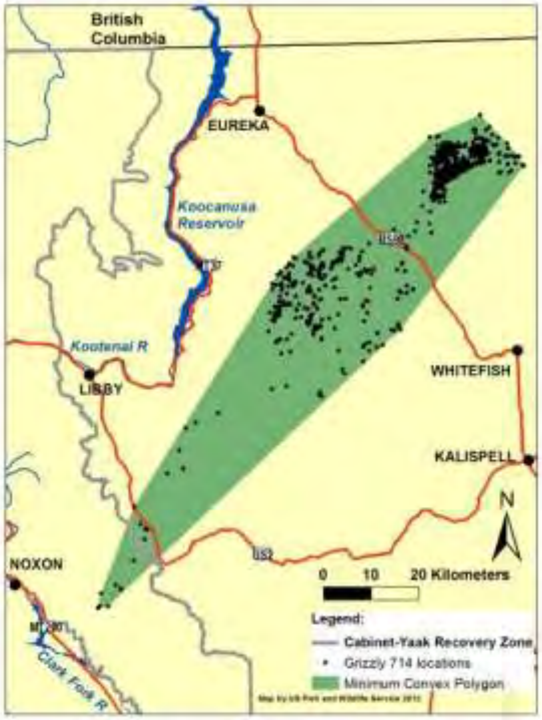

Figure A61. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 714 in the Cabinet Mountains, 2010–2012.

Figure A62. Radio locations and minimum convex (shaded) life range of male grizzly bear 1374 in the Yaak River, 2010.

Figure A63. Radio locations and minimum convex (shaded) life range of male grizzly bear 726 in the Yaak River, 2011–2012, 2015–2017.

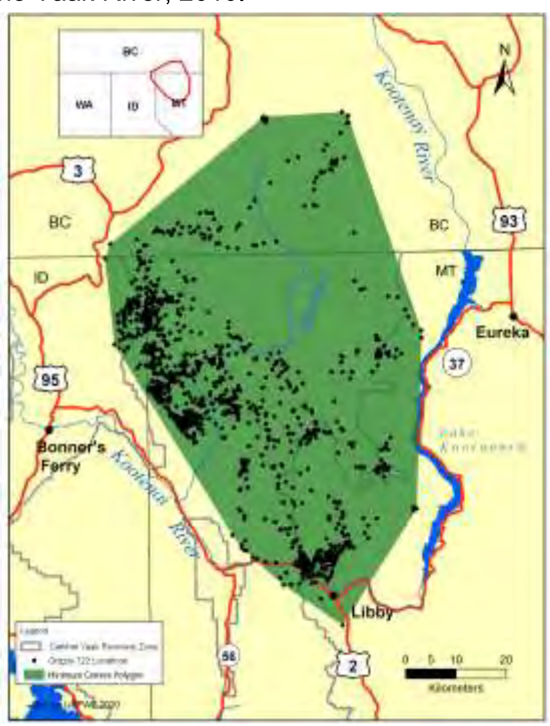

Figure A64. Radio locations and minimum convex (shaded) life range of male grizzly bear 722 in the Yaak River, 2011–2012, 2014, 2016–2019.

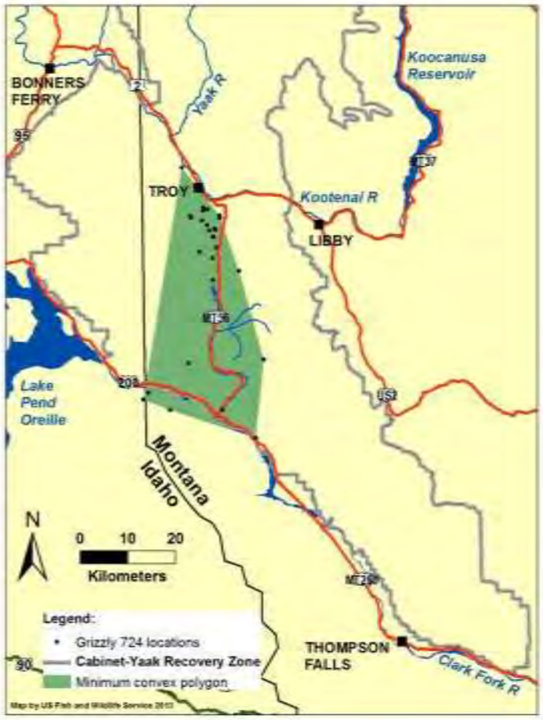

Figure A65. Radio locations and minimum convex (shaded) life range of management male grizzly bear 724 in the Cabinet Mountains, 2011–2012.

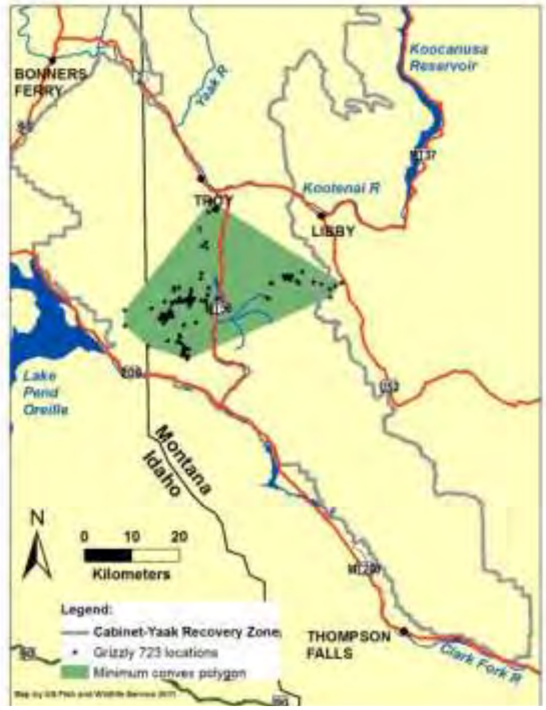

Figure A66. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 723 in the Cabinet Mountains, 2011–2012.

Figure A67. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 725 in the Cabinet Mountains, 2011–2013.

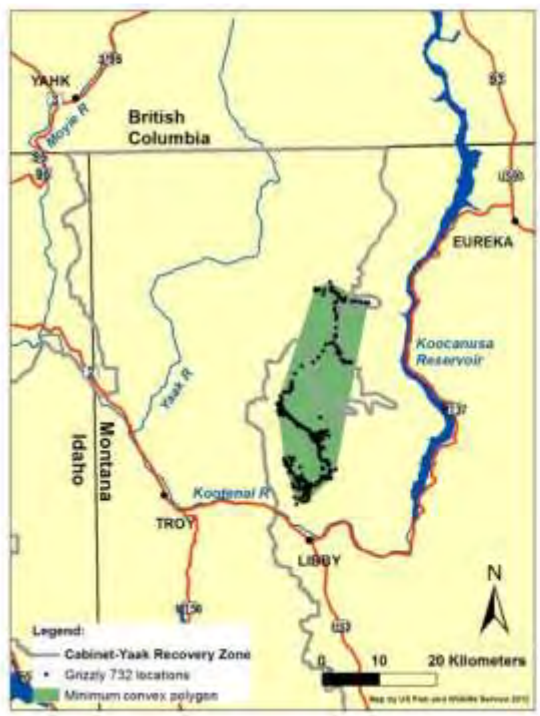

Figure A68. Radio locations and minimum convex (shaded) life range of management male grizzly bear 732 in the Yaak River, 2011.

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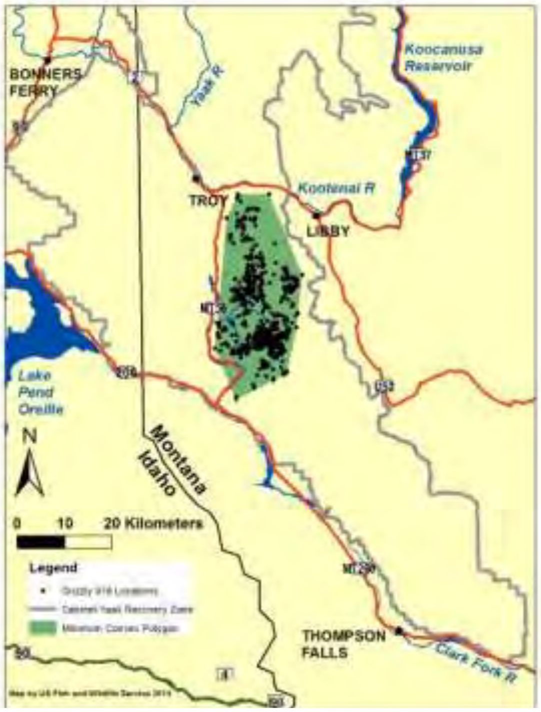

Figure A69. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 918 in the Cabinet Mountains, 2012–2014.

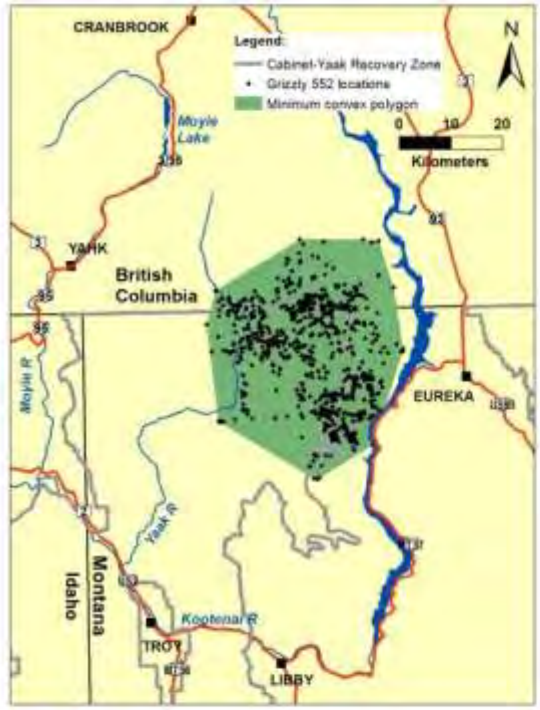

Figure A70. Radio locations and minimum convex (shaded) life range of female grizzly bear 552 in the Yaak River, 2012–2015.

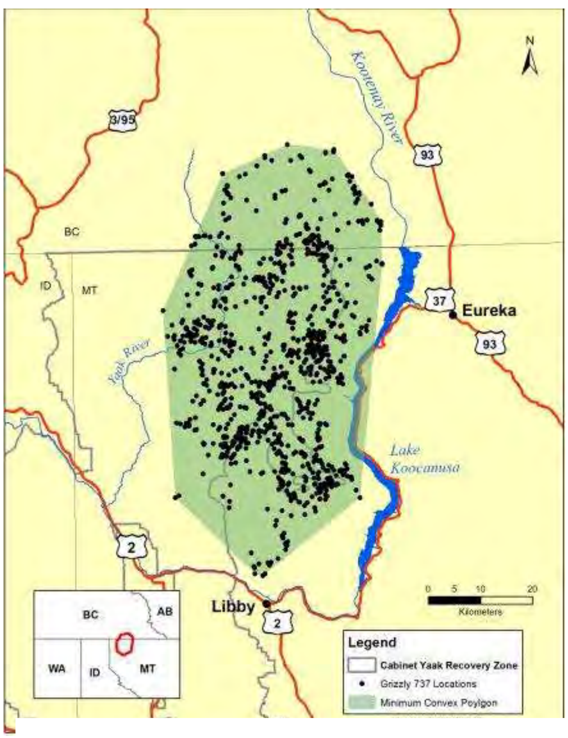

Figure A71. Radio locations and minimum convex (shaded) life range of male grizzly bear 737 in the Yaak River, 2010–2013.

Figure A72. Radio locations and minimum convex (shaded) life range of female grizzly bear 729 in the Yaak River, 2013–2017, 2020.

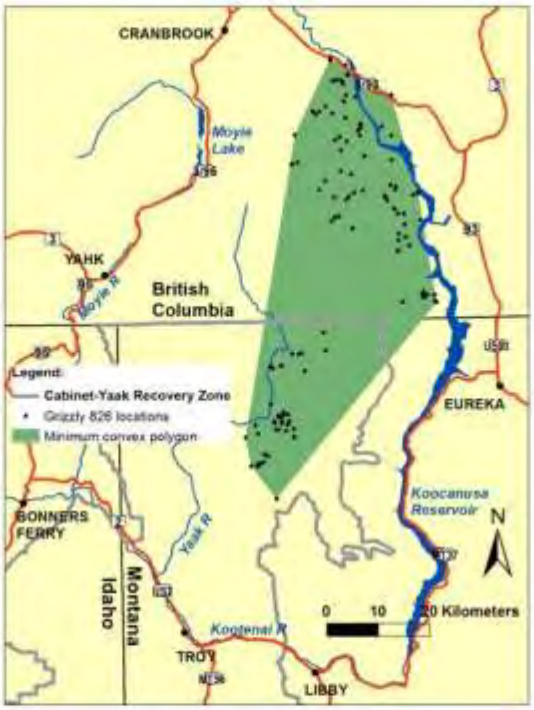

Figure A73. Radio locations and minimum convex (shaded) life range of male grizzly bear 826 in the Yaak River, 2013.

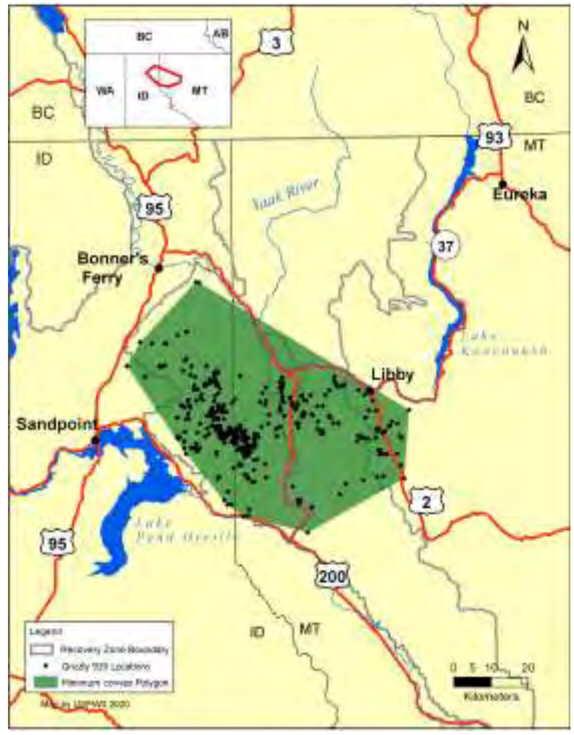

Figure A74. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 919 in the Cabinet Mountains, 2013–2014.

Figure A75. Radio locations and minimum convex (shaded) life range of female grizzly bear 831 in the Cabinet Mountains, 2014.

Figure A76. Radio locations and minimum convex (shaded) life range of male grizzly bear 835 in the Yaak River, 2014–2016, 2019–2020.

Figure A77. Radio locations and minimum convex (shaded) life range of male grizzly bear 837 in the Cabinet Mountains, 2014–2016.

Figure A78. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 920 in the Cabinet Mountains, 2014–2016.

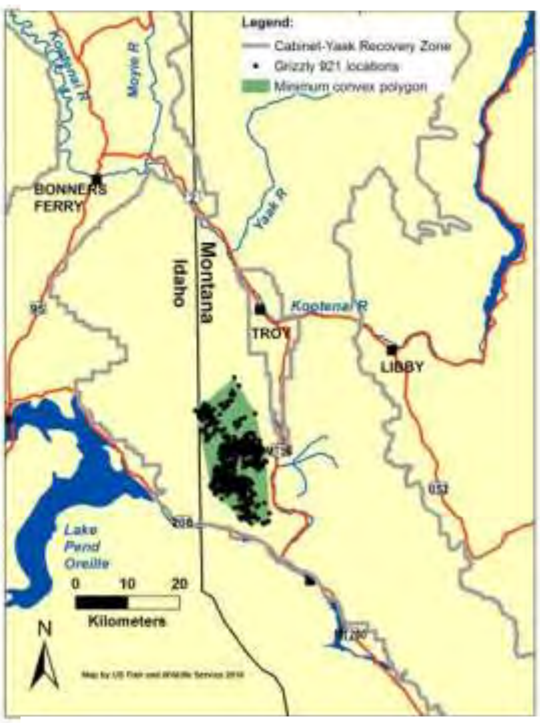

Figure A79. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 921 in the Cabinet Mountains, 2014–2015.

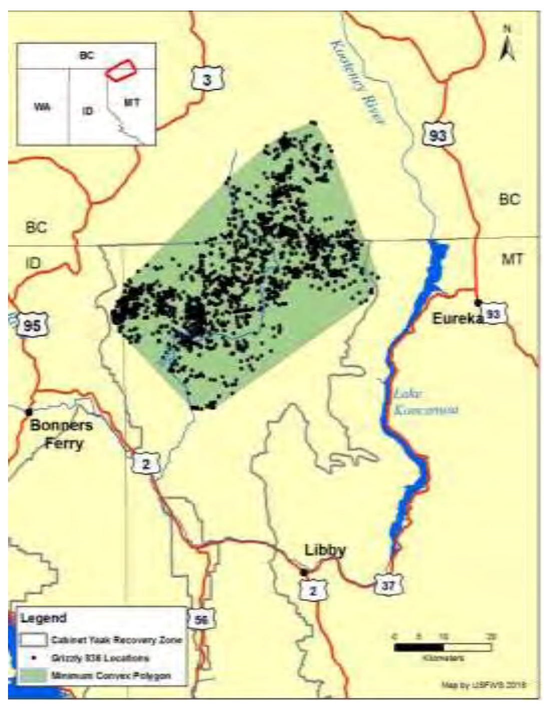

Figure A80. Radio locations and minimum convex (shaded) life range of female grizzly bear 836 in the Yaak River, 2014–2017.

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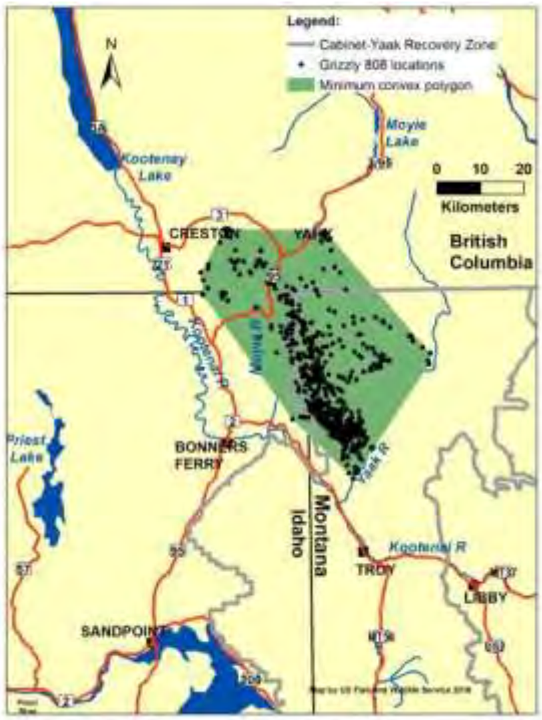

Figure A81. Radio locations and minimum convex (shaded) life range of male grizzly bear 808 in the Yaak River, 2014–2015.

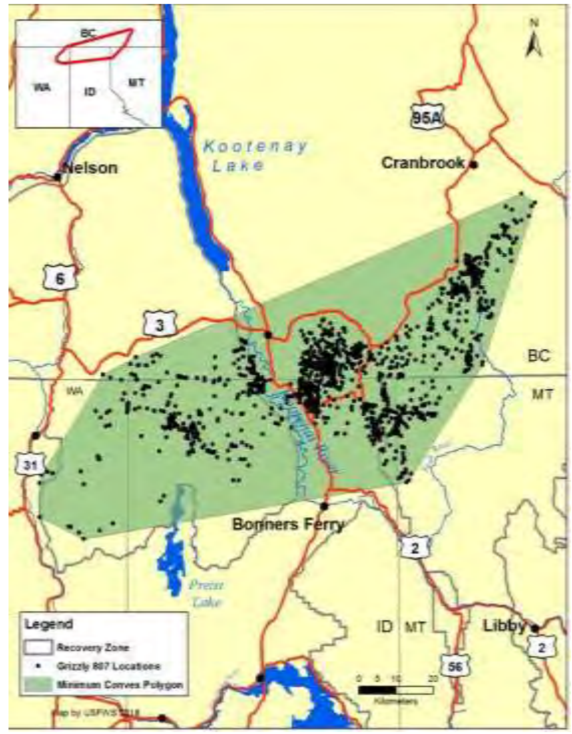

Figure A82. Radio locations and minimum convex (shaded) life range of male grizzly bear 807 in the Yaak River and Selkirk Mountains, 2014–2017.

Figure A83. Radio locations and minimum convex (shaded) life range of female grizzly bear 810 in the Yaak River, 2015–2018.

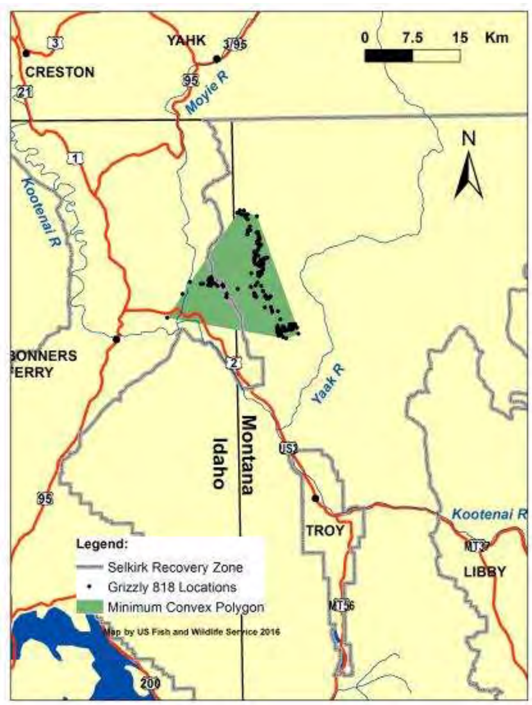

Figure A84. Radio locations and minimum convex (shaded) life range of male grizzly bear 818 in the Yaak River, 2015.

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Figure A85. Radio locations and minimum convex (shaded) life range of female grizzly bear 820 in the Yaak River, 2015–2018.

Figure A86. Radio locations and minimum convex (shaded) life range of male grizzly bear 839 in the Cabinet Mountains, 2015–2016.

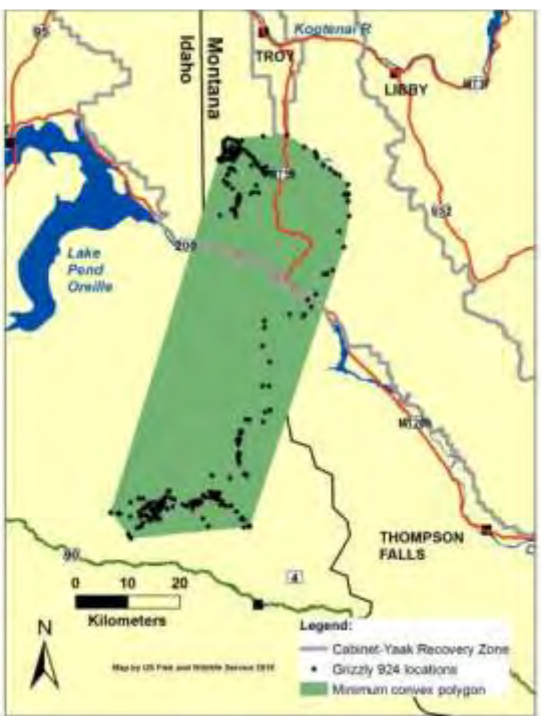

Figure A87. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 924 in the Cabinet Mountains, 2015.

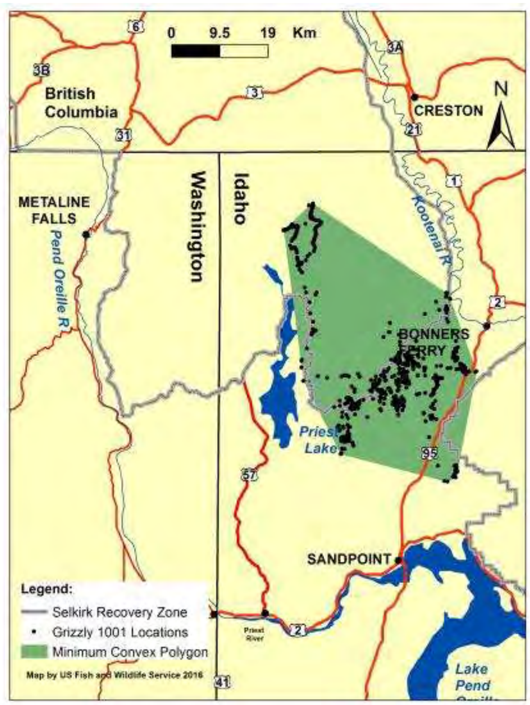

Figure A88. Radio locations and minimum convex (shaded) life range of male grizzly bear 1001 in the Selkirk and Cabinet Mountains, 2015.

Figure A89. Radio locations and minimum convex (shaded) life range of male grizzly bear 821 in the Yaak River, 2016–2017.

Figure A90. Radio locations and minimum convex (shaded) life range of male grizzly bear 822 in the Yaak River, 2016, 2019–2020.

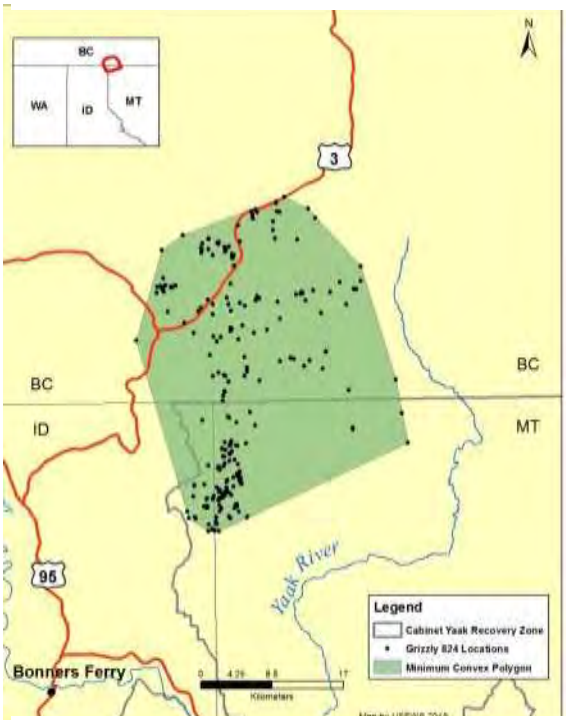

Figure A91. Radio locations and minimum convex (shaded) life range of male grizzly bear 824 in the Yaak River, 2016–2017.

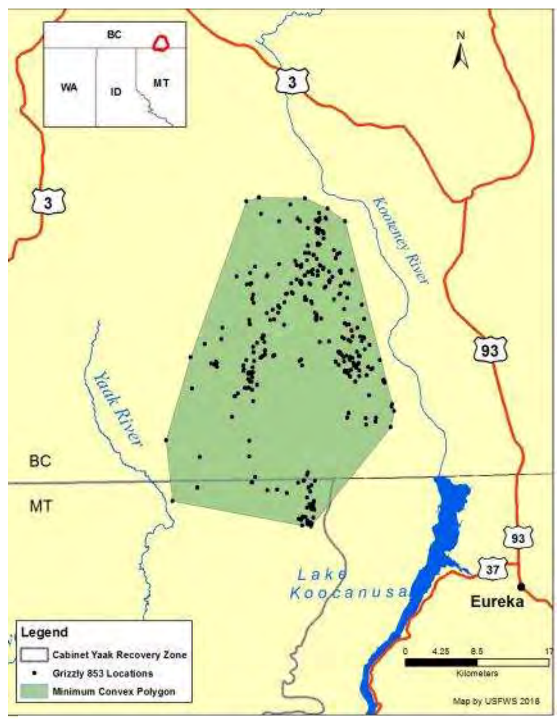

Figure A92. Radio locations and minimum convex (shaded) life range of male grizzly bear 853 in the Yaak River, 2016–2017.

Figure A93. Radio locations and minimum convex (shaded) life range of male grizzly bear 9811 in the Yaak River, 2016–2018.

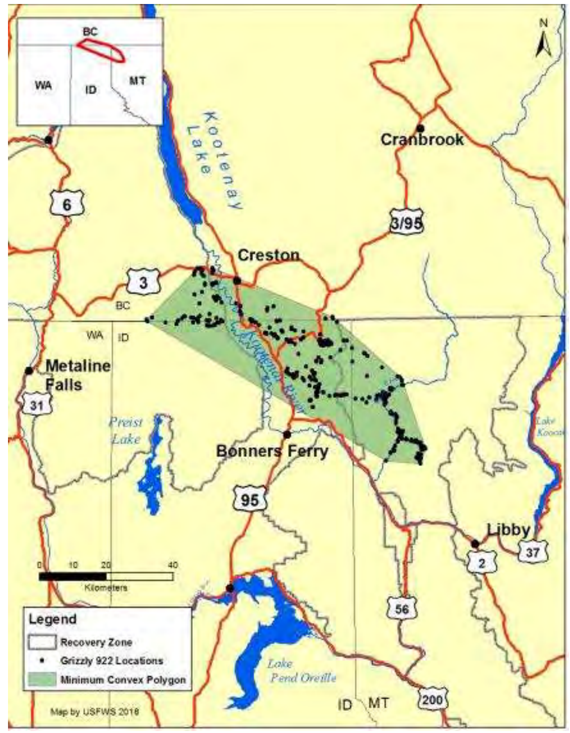

Figure A94. Radio locations and minimum convex (shaded) life range of male grizzly bear 922 in the Yaak River, 2016–2017.

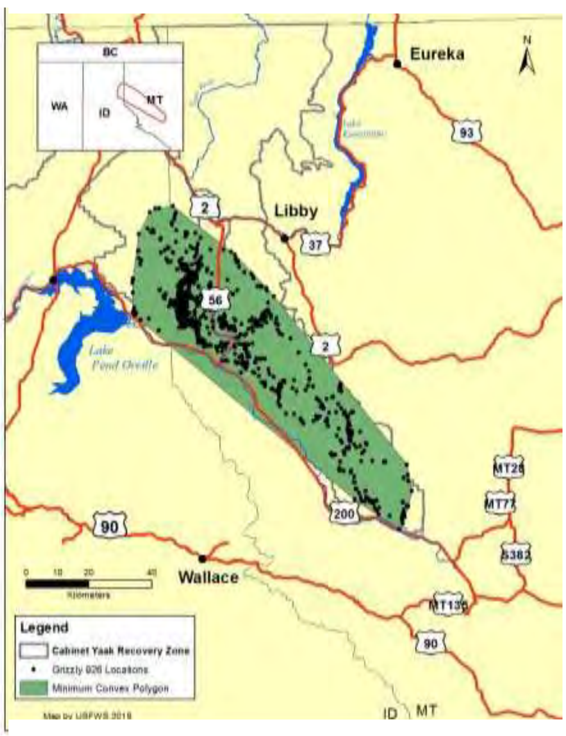

Figure A95. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 926 in the Cabinet Mountains, 2016–2017.

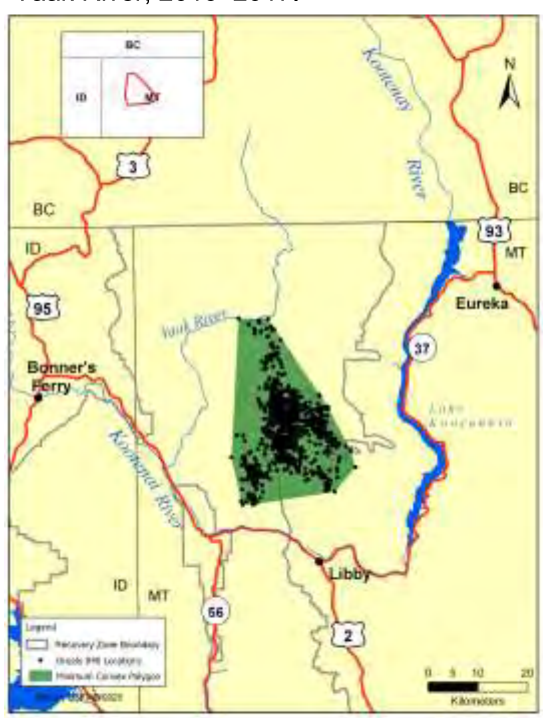

Figure A96. Radio locations and minimum convex (shaded) life range of female grizzly bear 840 in the Yaak River, 2016–2019.

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Figure A97. Radio locations and minimum convex (shaded) life range of female grizzly bear 842 in the Yaak River, 2017–2019.

Figure A98. Radio locations and minimum convex (shaded) life range of male grizzly bear 861 in the Cabinet Mountains, 2017–2019.

Figure A99. Radio locations and minimum convex (shaded) life range of management female grizzly bear 1026 in the Yaak River, 2017.

Figure A100. Radio locations and minimum convex (shaded) life range of management female grizzly bear 1028 in the Yaak River, 2017.

Figure A101. Radio locations and minimum convex (shaded) life range of augmentaiton male grizzly bear 927 in the Cabinet Mountains, 2018–2020

Figure A102. Radio locations and minimum convex (shaded) life range of male grizzly bear 1006 in the Selkirk, Purcell, and Cabinet Mountains, 2017–2018.

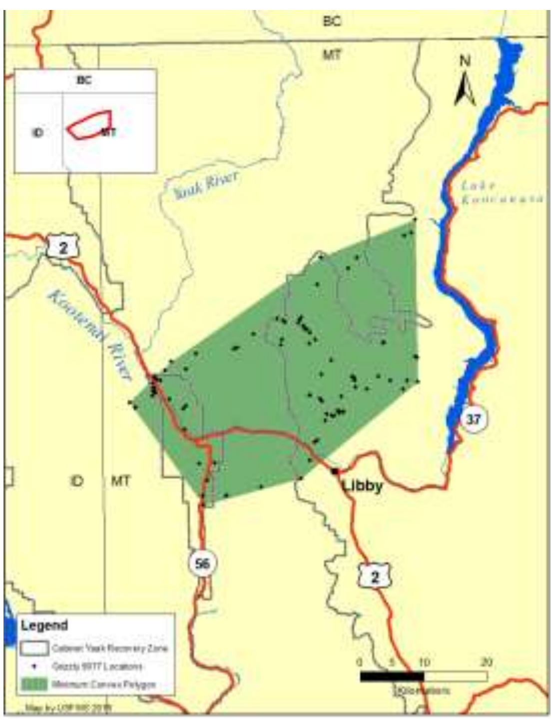


Figure A103. Radio locations and minimum convex (shaded) life range of management male grizzly bear 9077 in the Yaak River, 2018.

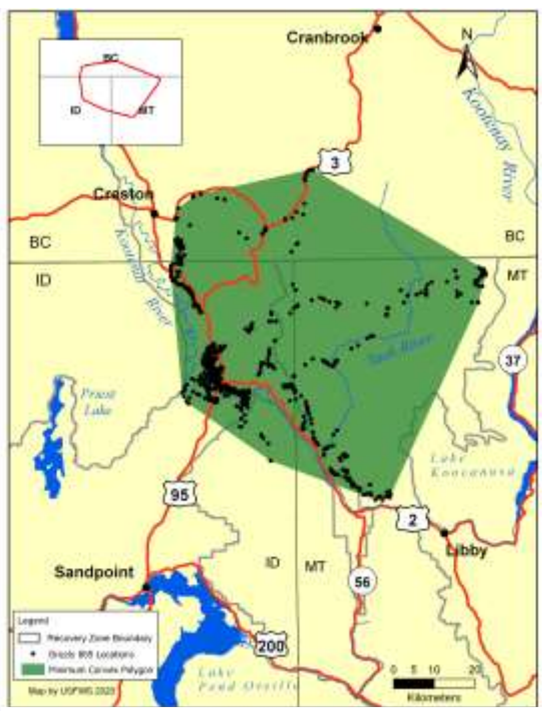


Figure A104. Radio locations and minimum convex (shaded) life range of management male grizzly bear 865 in the Kootenai and Yaak River, 2018–2019.

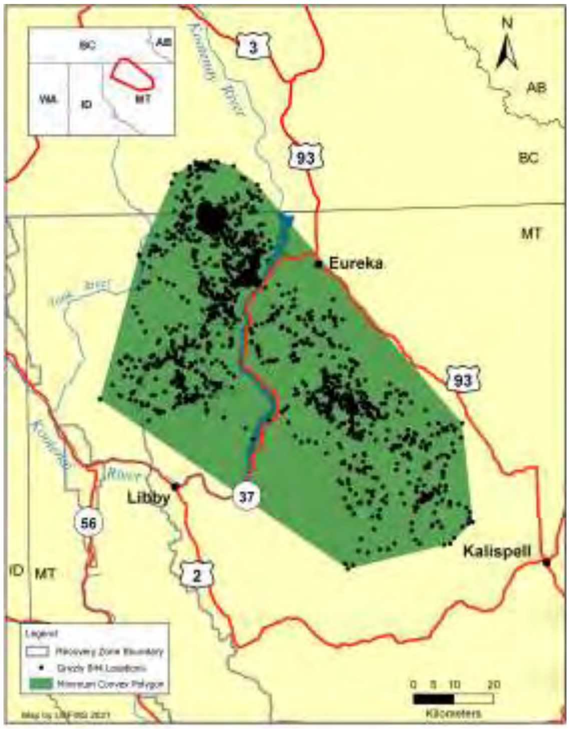


Figure A105. Radio locations and minimum convex (shaded) life range of augmentaiton male grizzly bear 844 in the Yaak River, 2019–2020.

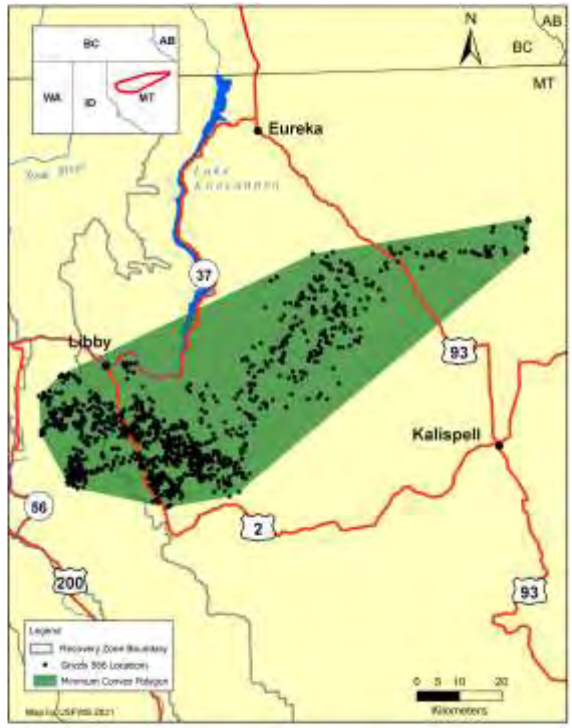


Figure A106. Radio locations and minimum convex (shaded) life range of male grizzly bear 866 in the Cabinet Mountains, 2019–2020.

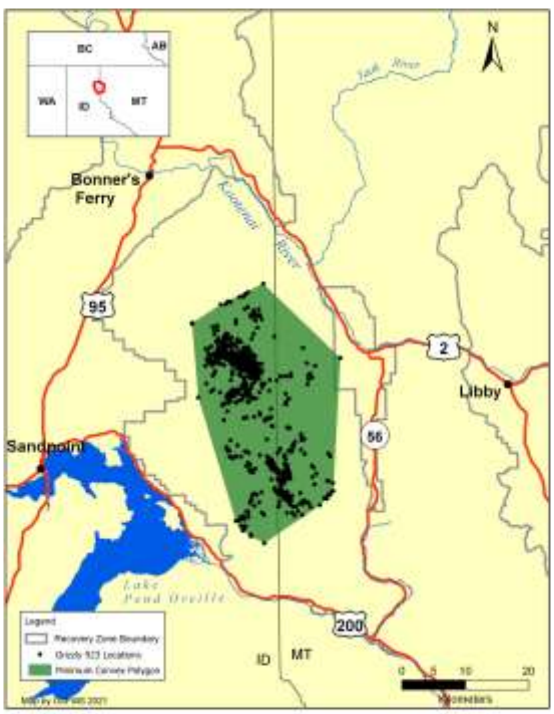


Figure A107. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 923 in the Cabinet Mountains, 2019–2020.

Figure A108. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 892 in the Cabinet Mountains, 2019–2020.

FWS001546

APPENDIX 5. Fine scale habitat modeling for the South Selkirk and Cabinet-Yaak ecosystems

Trans-border Grizzly Bear Project and the US Fish & Wildlife Service
Michael Proctor TBGBP and Wayne Kasworm USFWS

BACKGROUND

This document describes the methods and appropriate interpretation for fine scale habitat modeling of sex-, season- and ecosystem-specific habitat use modeling for grizzly bears. We modeled habitat use for females and males, in each of 3 seasons (spring, summer, fall) in each of 4 ecosystems, S Purcells in Canada, the international South Selkirks and Yaak, and the US Cabinets. Here we present the female results. Females receive priority in grizzly bear conservation management because they are the reproductive engine of a population, they tend to have smaller home ranges and move significantly less than males. Management that secures important female habitat and food resources may be most efficient for conservation purposes. Males are important as well and, in some instances, can dominate the very best of food resources.

METHODS

We assessed habitat use for female and male bears separately at the scale of each of several ecosystems, including the South Selkirk (international), the Yaak (international), the Cabinets (USA) and the South Purcell (north of Hwy 3 in Canada). We modelled habitat in each of the 3 non-denning seasons (Spring, den emergence – July 14; Summer berry season, July 15 – Sept 15; and Fall, Sept 16 – October 30). Methods below are very similar to those employed by Proctor *et al*. 2015.

Grizzly bear GPS location data

We deployed GPS-telemetry collars on 38 female grizzly bears in 2004–2015 (22 in the international S Selkirks, 10 in the International Yaak and 6 in the Canadian South Purcells). Bears were captured with Aldrich foot snares and occasionally with culvert traps. We used Telonics Inc. (Mesa, Arizona, USA) Spread Spectrum radio-collars (and occasionally store-on-board collars) and remotely downloaded bear locations on a periodic basis.

Most bears were collared in May or June and were monitored for 1–3 years but usually monitoring spanned at least 2 non-denning periods (i.e., spring summer, fall). Locations were attempted every 1–4 hours depending on collar size (smaller bears carried smaller collars with less battery life), and age of bears (subadult bears carried collars designed to drop off earlier so as to not interfere with neck growth). Because we used only 2D and 3D fixes, overall fix success (the proportion of 2D and 3D fixes relative to fix attempts) was 84%. We also assessed potential location bias for canopy closure, which was the variable with the most potential for low fix success rate (Frair *et al*. 2004). We placed 13 GPS radio collars at ground level in conifer forest with canopy cover from 0 to 75% canopy and found no relationship between fix rate and canopy closure ($R^2 = 0.07$; regression significance, $P = 0.64$).

Because unequal observations among animals can lead to biased population level estimates (Gillies *et al*. 2006) and most bears had 1500–2000 locations, we used a maximum of 1600 locations from most bears by removing every n^{th} location from any one bear with > 1600 locations.

Grizzly Bear Habitat Modeling

Female grizzly bear GPS telemetry data were divided into 2 groups for each season and ecosystem. An 80% random sample was used for model training, while the remaining 20% random samples of bear locations were withheld for model evaluation (Boyce *et al*. 2002,

Nielsen *et al*. 2002). We used the GPS telemetry locations and a similar number of available (random) locations from within the composite home ranges of all grizzly bears to develop a resource selection function (RSF, Boyce and McDonald 1999, Manly *et al*. 2002, Nielsen *et al*. 2002). We estimated the parameters of the exponential RSF using logistic regression (Manly *et al*. 2002) and predictions from the RSF were transformed using the logistic function to normalize the right skewing of exponential RSF values and then mapped at a 100-m scale in ArcGIS 10.1 (ESRI, Redlands, CA). Logistic regression was performed using the statistical software package STATA (Intercooled 9.2, College Station, Texas, USA).

Model building was based on the principles of Hosmer and Lemeshow (1989) and more recently referred to as purposeful selection of variables (Bursac *et al*. 2008). We did not use an Information Theoretic approach (Burhnam and Anderson 1998) because our goal was predictive ability of grizzly bear habitat use and not testing of broader competing hypotheses (Nielsen *et al*. 2010). All predictor variables were tested for pairwise correlations (Chatterjee *et al*. 2000) and only terrain ruggedness and compound topographic index were correlated. All variables and their quadratic relationships were fit individually (uni-variable analyses) and ranked for their significance and explanatory power (pseudo R^2). Multi-variable models were then built by adding non-correlated variables in a forward stepwise fashion starting from higher to lower pseudo R^2. Models were compared sequentially after each variable addition; variable significance and explanatory power (pseudo R^2) were used to compare models and decide if a variable improved model predictability. When a variable increased the pseudo R^2 by at least 5%, we retained that variable in the model; when a variable increased the pseudo $R^2 < 5\%$ we did not retain it to favor a parsimonious model.

We used the Huber-White sandwich estimator in the robust cluster option in Stata to calculate standard errors because non-independent locations can lead to biased standard errors and overestimated significance of model parameters (White 1980, Nielsen *et al*. 2002, 2004b). Because the bears were the unit of replication, they were used to denote the cluster thus avoiding autocorrelation and/or pseudoreplication of locations within individual bears. We assessed the Receiver Operator Characteristic (ROC), a standard technique for summarizing classifier performance (i.e., how well did the model predict habitat and non-habitat correctly) for our most parsimonious models.

Environmental Variables

We used variables that were most consistently measured across the study area and between Canada and the USA including human-use, terrain, forest cover, and other ecological variables (Table 1). Ecosystem characteristics and human uses in the adjacent south Selkirk and south Purcell Mountains are similar (Meidinger and Pojar 1991) allowing development and prediction of models to these areas. Lowlands are dominated by Cedar-Hemlock (*Thuja plicata* - *Tsuga heterophylla*) forests and upland forests are dominated by Engelmann Spruce - Sub Alpine Fir (*Picea engelmanni – Abies lasiocarpa*). Douglas fir (*Psuedotsuga mensiezii*) forests are somewhat more common in the southern portions of the Purcell range (Meidinger and Pojar 1991). Human uses are relatively similar across the region and include timber harvest, some mining, ungulate hunting, and other forms of recreation.

Baseline Thematic Mapping land-cover variables (recently logged, alpine, avalanche, and riparian), Vegetation Resource Inventory variables (dominant tree species forest cover types, canopy cover), and backcountry resource roads (i.e., associated with timber harvest, mining) were obtained from the BC Ministry of Forests, Lands, and Natural Resource Operations in Canada. Land-cover information for the USA was from the US Forest Service. Alpine, avalanche, burned, and riparian habitats contain a variety of grizzly bear food resources (Mace *et al*. 1996, McLellan and Hovey 1995, McLellan and Hovey 2001b). Forest cover variables (Table 1) were used because they often have been found to influence grizzly bear habitat selection (Zager *et al*. 1983, Waller and Mace 1997, Apps *et al*. 2004, Nielsen *et al*.

2004a). Greenness, an index of leafy green productivity, correlates with a diverse set of bear food resources and is often found to be a good predictor of grizzly bear habitat use (Mace *et al*. 1996, Nielsen *et al*. 2002). Greenness was derived from 2005 Landsat imagery using a Tassled Cap transformation (Crist and Ciccone 1984, Manley *et al*. 1992). Terrain variables of elevation, compound topographic index (CTI), solar radiation, and terrain ruggedness were derived from a digital elevation model (DEM) in ArcGIS. CTI is an index of soil wetness estimated from a DEM in a GIS using the script from Rho (2002). Solar radiation was estimated for the summer solstice (day 172), again using a DEM, and in this case the ArcInfo AML from Kumar (1997) that was modified by Zimmerman (2000) called shortwavc.aml. Finally, terrain ruggedness was estimated from the DEM based on methods from Riley *et al*. (1999) and scripted as an ArcInfo AML called TRI.aml (terrain ruggedness index) by Evans (2004). These terrain variables have been shown to influence the distribution of grizzly bear foods (Apps *et al*. 2004, Nielsen *et al*. 2004a, 2010) and also affect local human use. We included elevation as a variable because grizzly bears in our region use high country extensively, which may be for a variety of reasons (e.g., high elevation habitat types, thinner forest cover with more edible ground-based vegetation, human avoidance). Highway and human developments were digitized from 1:50,000 topographic maps and ortho-photos. Highway, human developments, and backcountry roads were buffered by 500 m on either side to reflect their influence on grizzly bear habitat use (Mace *et al*. 1996). The human-use variables have been demonstrated repeatedly to correlate with habitat selection by grizzly bears (Mace *et al*. 1996, 1999, Nielsen *et al*. 2002, Apps *et al*. 2004). Although none of the predictors were direct measures of food resources or human activities, each factor was thought to correlate with resources and behaviors used by bears or activity of humans (Mace *et al*. 1996, Nielsen *et al*. 2002, 2006, 2009, Apps *et al*. 2004).

RESULTS

Best models for each season and ecosystem were dominated by greater than expected use for canopy openness and high level of greenness and less than expected use of high road densities (Table 1). Model predictive ability was greatest in the International South Selkirk area in all 3 seasons, as predictions of habitat use and non-use were all > 0.8 (ROC, Receiver Operator Characteristic measures how well the model predicts habitat use (GPS Locations that were in model predicted use areas vs non-used areas). Because we had very few resident females in the Cabinet population, most were augmented bears from the Rocky Mt region, and the ecology is similar to the S Selkirk region (Proctor *et al*. 2015), we applied our South Selkirk model to the Cabinet area. These models are similar to the all-season both-sex Resource Selection Function model derived to predict linkage habitat within Proctor *et al*. (2015). That model was dominated by canopy openness, greenness, riparian, alpine, and elevation.

In the S Selkirk, S Purcell, and Cabinet area, our models were the most predictive with ROC scores usually > 0.75 and even > 0.80 (0.7 is considered a good predictive model). Models for the international Yaak were less predictive, especially in spring and fall (ROC scores were 0.66 and 0.59 respectively).

Where we had a huckleberry patch model available in the South Purcell area of Canada, it dominated the model along with greenness. We have a huckleberry patch model throughout this region within Canada. Therefore, we did not include it in international models in the S Selkirk, Yaak, or Cabinet areas. Canopy openness is a powerful predictor of huckleberry patches and in models without huckleberry patches, canopy openness plays a similar predictive role.

DISCUSSION

We envision the usefulness of these habitat models for planning timber harvest, road building, road closing, road decommissioning, and prescribed burns. As canopy openness and

greenness are two of the better predictors of female habitat use (Mace *et al*. 1996, Nielsen et al. 2002), certain timber harvest and prescribed burning practices may have some potential to improve grizzly bear habitat through opening canopy and promoting deciduous and herbaceous bear foods. In contrast, it might be desirable to plan access controls in areas where habitat quality and use is high, to provide security for female grizzly bears. In that regard, these models may be used to decide where roads might be closed, decommissioned, or left open.

It must also be kept in mind that grizzly bear habitat is dynamic spatially and temporally. Some open-canopy habitats that resulted from past timber harvest may change over time as those canopies fill in with forest regrowth. The same applies to habitat created from past burns. Also, some habitat may have a longer-term state of canopy openness (some higher elevation forests) that may remain desirable over longer time periods. Foresters' on-the-ground knowledge may be able to differentiate these types of habitats and their dynamic potential. Future iterations of these models can be run with updated canopy cover and greenness layers as they are derived from remote sensing.

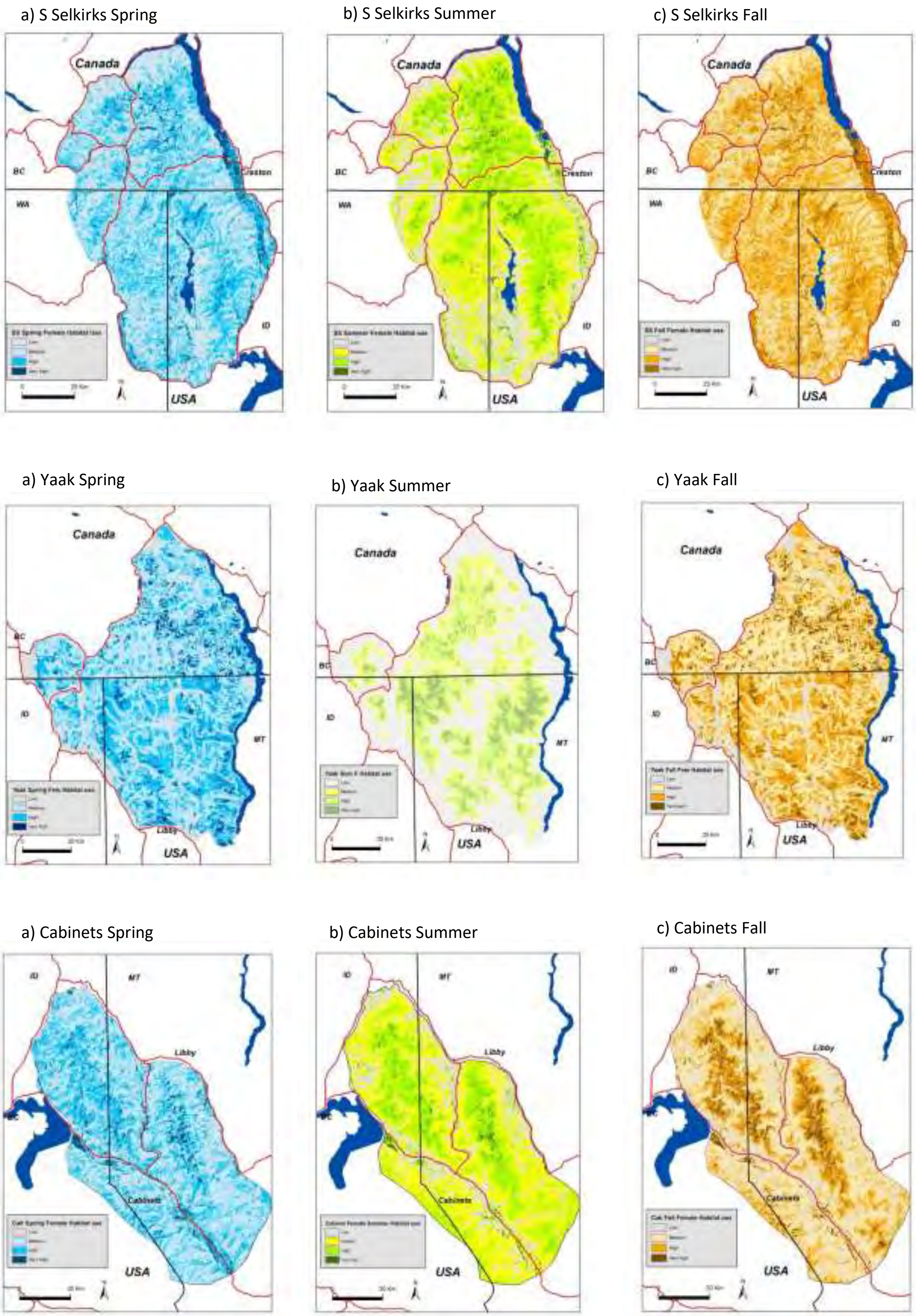
Note that Riparian habitat was a strong predictor in the South Selkirk (and Cabinet) model. This result was driven by the heavy use of female grizzly bears in the Kootenay River Valley just north of the Canada-US border in the Creston Valley in all 3 seasons. If populations continue to grow, the Kootenay River Valley or other main river valleys may see some increased habitat use by female grizzly bears at least seasonally within the US. We also think that the bears in the Creston Valley are getting a measure of agricultural foods that might be holding them in the valley even in the summer. In Canada and the US, there are developing programs to secure many of these agricultural products from the bears, but it may never all be secured and there will tend to be some bears spending time in these valley bottoms. On the other hand, this is somewhat desirable from the standpoint of female connectivity between the Selkirk and Purcell and Cabinet ranges (Proctor *et al*. 2012, 2015). Subadult female dispersal is usually of a short distance (McLellan and Hovey 2001, Proctor *et al*. 2004) so for female connectivity to develop, it is likely necessary that female grizzly bears spend a portion of their lives in valley bottoms. Conflict reduction efforts become especially important in that regard.

As we modeled each ecosystem separately, thresholds between ecosystems varied. Model outputs have ecosystem-specific thresholds for greater than expected use of specific habitats vs. less than expected use built in. For most planning we would expect use of the summer models or occasionally the spring models. Fall modeling probably represents a time when berry feeding has passed, and bears may be preparing for denning by looking for protein in the form of wounded animals and gut piles from hunters.

Table 1. Best female grizzly bear seasonal habitat use models for the Selkirk, S Purcell, Yaak, and Cabinet ecosystems. Huckleberry patch models were only available in the S Purcell area.

VARIABLES	Female Selkirk Spring	Female Selkirk Summer	Female Selkirk Fall	Female Yaak Spring	Female Yaak Summer	Female Yaak Fall	Female Cabinet Spring	Female Cabinet Summer	Female Cabinet Fall	Female Purcell Spring	Female Purcell Summer	Female Purcell Fall	Female Canada Spring	Female Canada Summer	Female Canada Fall
canopy cover	-	+	+	-	+	+	-	+	+	+			-		
canopy cover^2		-	-		-	-		-	-						
greenness	+	+	+		+		+	+	+	+	+	+	+	+	+
road density	-	-	-	-			-	-	-				-	-	-
riparian	+	+	+				+	+	+					+	
forest age 100-250											-	-			
forest age 1-20					+										
forest age 20-60						-									
forest age 60-80											+				
alpine					+	+						+		+	+
avalanche	+						+						+		
deciduous forest				+	+	+				+					
elevation		+	+	+	+			+	+						
elevation^2			-	-	-				-						
Douglas fir forest			-	+					-						-
distance to road											+				
buildings				-	-										
distance to HuckPatch											-			-	-
HuckPatch X Dist2Road															+
highway			-			-			-						-
mortality risk				-								-			+
recently logged			-						-		-	-			
solar radiation										+		+			
terrain ruggedness										+				-	-
Pseudo R2	0.20	0.25	0.26	0.06	0.18	0.03	0.20	0.25	0.26	0.20	0.32	0.11	0.13	0.25	0.15
ROC AUC	0.80	0.82	0.83	0.66	0.78	0.59	0.80	0.82	0.83	0.79	0.86	0.73	0.75	0.82	0.80
Correct classified	73%	74%	80%	61%	70%	56%	73%	74%	80%	72%	78%	65%	74%	75%	76%

Figure 1a) Spring, b) Summer, and c) Fall female grizzly bear Habitat Use map.



FWS001552

SELKIRK / CABINET-YAAK GRIZZLY BEAR RECOVERY ZONES
2019 ANNUAL MONITORING SUMMARY REPORT
Colville, Idaho Panhandle, Kootenai, and Lolo National Forests
04-17-2020

Introduction

In 2011 the U. S. Fish and Wildlife Service issued their Biological Opinion for the Grizzly Bear Access Amendment of the Kootenai, Idaho Panhandle, and Lolo National Forest Plans (USDI 2011). This document directed the Forest Service to report annually on their progress made towards achieving Interagency Grizzly Bear Committee (IGBC) access management standards for the Selkirk and Cabinet-Yaak Recovery Zones (USDI 2011). These standards include open and total motorized route densities (OMRD & TMRD), and core areas for each bear management unit (BMU) in the two recovery zones. There are also standards for allowable administrative use of restricted access (gated) roads, and road closure monitoring effort. Lastly, the Forest Service was to meet annually with other agency biologists to update the Bears Outside of Recovery Zones (BORZ) database (ibid).

Each grizzly bear recovery zone is divided into individual bear management units (BMUs) which biologists use for habitat evaluation and population monitoring. An individual BMU is roughly 100 square miles in size; the approximate area required for supporting an adult sow with cubs.

Roads provide access for people into grizzly bear habitat. In areas of high road densities, grizzly bears are prone to being disturbed by vehicle traffic or people on foot. A bear may learn to avoid areas near open roads, forgoing access to any suitable habitats within the road corridor. The risk of a grizzly being shot is higher in areas with high road densities, than in areas with few or no roads. Each BMU has its own set of standards for open and total motorized route densities. Areas influenced by high road densities should not exceed a defined maximum percentage of each BMU. A minimum percent of each BMU should be providing core habitat, defined as lands lying further than 500 meters from open or restricted access roads.

2019 Access Parameter Status

Tables 1 and 2 summarize the habitat parameters related to roads within the two recovery zones for the 2019 "bear year".

Table 1. BMU summary for the 2019 bear year [April 1 through November 30] in the Cabinet-Yaak Recovery Zone. Values in blue reflect existing BMU standards (USDA 2011). Values in red indicate parameters that did not meet standards in 2019.

Bear Management Unit*	Open Roads >1 mi/mi² (%)	Total Roads >2 mi/mi² (%)	% Federal Land	% Core	Priority
CABINET-YAAK RECOVERY ZONE					
1-Cedar	16 (15)	10 (15)	99	84 (80)	2
2-Snowshoe	16 (20)	14 (18)	94	77 (75)	2
3-Spar	29 (33)	26 (26)	95	62 (59)	3
4-Bull	38 (36)	30 (26)	84	61 (63)	2
5-St. Paul	28 (30)	23 (23)	97	58 (60)	1
6-Wanless	32 (34)	34 (32)	85	53 (55)	1
7-Silver Butte	24 (26)	23 (23)	92	65 (63)	2
8-Vermilion	32 (32)	22 (21)	93	58 (55)	3
9-Callahan	29 (33)	29 (26)	90	57 (55)	2

Bear Management Unit*	Open Roads >1 mi/mi² (%)	Total Roads >2 mi/mi² (%)	% Federal Land	% Core	Priority
10-Pulpit	45 (44)	28 (34)	95	54 (52)	2
11-Roderick	29 (28)	26 (26)	96	56 (55)	1
12-Newton	43 (45)	32 (31)	92	54 (55)	1
13-Keno	34 (33)	24 (26)	99+	59 (59)	1
14-NW Peak	29 (31)	24 (26)	99+	56 (55)	1
15-Garver	32 (33)	27 (26)	94	54 (55)	1
16-EF Yaak	30 (33)	25 (26)	96	54 (55)	1
17-Big Creek	30 (33)	15 (26)	99	58 (55)	2
18-Boulder	32 (33)	31 (29)	92	52 (55)	3
19-Grouse	64 (59)	61 (55)	54	30 (37)	3
20-North Lightning	35 (35)	18 (20)	94	64 (61)	1
21-Scotchman	34 (34)	24 (26)	81	65 (62)	2
22-Mt. Headley	35 (33)	37 (35)	89	53 (55)	3

*BMUs 1-17 parameters reported by the Kootenai NF, BMUs 18, 19, 20, & 21 parameters reported by the Idaho Panhandle NFs, BMU 22 parameters reported by the Lolo NF

Table 2. BMU summary for the 2019 bear year [April 1 through November 15] in the Selkirk Recovery Zone. Values in blue reflect existing BMU standards (USDA 2011). Values in red indicate parameters that did not meet standards in 2019.

Bear Management Unit*	Open Roads >1 mi/mi² (%)	Total Roads >2 mi/mi² (%)	% Federal Land	% Core	Priority
SELKIRK RECOVERY ZONE					
Blue Grass	30 (33)	29 (26)	96	48 (55)	1
Long-Smith	24 (25)	16 (15)	92	71 (67)	1
Kalispell-Granite	33 (33)	24 (26)	96	55 (55)	1
Salmo-Priest	27 (33)	23 (26)	99	68 (64)	2
Sullivan-Hughes	23 (23)	18 (18)	99	63 (61)	1
Myrtle	32 (33)	23 (24)	85	58 (56)	2
Ball-Trout	16 (20)	11 (13)	94	72 (69)	2
Lakeshore	80 (82)	44 (56)	86	22 (20)	3
LeClerc	44 (48)	56 (60)	64	27 (27)	3

*Salmo-Priest, Sullivan-Hughes, and LeClerc BMU parameters reported by the Colville NF. All other BMU parameters reported by the Idaho Panhandle NFs.

Tables 3 and 4 summarize the specific management actions that resulted in changes to access parameters in each BMU from 2018 to 2019.

Table 3. Management actions that resulted in changes to OMRD, TMRD or Core habitat from 2018 to 2019 in the Cabinet-Yaak Recovery Zone on the Idaho Panhandle, Kootenai, and Lolo National Forests.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
1-Cedar	OMRD increased 2% to 16%, and TMRD increased 2% to 10%. No change to Core at 84%. At the end of bear year (BY) 2019, BMU 1 either meets (OMRD) or is better than its individual standards (TMRD and core). On the Libby RD, administrative use on Flower Cr Ridge E FR 4729E, accessed via gate on 4729, exceeded allowable use levels during the summer period and contributed to open route densities within the BMU. This administrative use of FR 4729E was analyzed and approved for sale prep activities under the Flower Creek Project. Public use did not occur. Outside the BMU boundary, but within the BMU buffer, a motorized breach by dirt bikes getting around the gate on Flower Creek F FR 128F occurred, and the road was modeled as open for the bear year. On the Three Rivers RD portion of BMU1, all administrative use was within allowable levels and there was no unauthorized motorized or emergency fire access. Also affecting route densities in 2019 were database updates (no change on the ground) to include the existing Burlington Northern Railroad tracks and railroad access roads.
2-Snowshoe	OMRD decreased by 3% to 16%, TMRD decreased by 1% to 14%, and core remained at 77%. BMU 2 is 4% lower and better than its standard for OMRD (20%) and TMRD (18%) and 2 percent higher and better than its core standard (75%). At the end of BY 2019, BMU 2 is better than its individual standards in all habitat parameters. Contributing to the decrease in open motorized route densities were 2018 repairs to breached or damaged gates. These repairs included gates on the Deep Creek Roads (FRs 7716 and 7716A) and Smearl Creek Road FR 4790 and the associated Stimson spur road #99775. These repairs resulted in these roads being restricted to unauthorized motorized use. Other routes identified in 2017 and 2018 as open, Lower Granite T Road (FR 4791T) and FR 5140, were bermed in fall of 2018 and remained effectively closed to motorized use in 2019. In addition the remaining segment of the old Luken Hazel Development Road (FR 8646) on the private land and the segments of FR 8646A on the private land have been gated. Several other changes, including repairs to contributed to changes in core acres, including a database update for Road #5145 Officer Lake – Old Snowshoe, located on private and NFS land which contributed to an increase in core acres. This road is impassable on both the private and NFS land. Based on visitor use records, the determination was made to include the Leigh Lake Trail as a high-use non-motorized trail, which contributed to a decrease in 403 acres of core. These changes did not result in a change the percentage of core. Several roads contributed to open motorized route density in bear year 2019. Normally gated road (4791N) was reported to have vehicles driving around the gate in August of 2019 and a new berm was installed along side of the gate in September of 2019. The road was considered open for the 2019 bear year. As first documented in BY 2018, the segment of Cherry Creek Road (FR 867) across the private land remained open and drivable through 2019 and contributed to open route densities. Also contributing to route densities was unauthorized motorized use which occurred on a user-created route connecting the end of stored undetermined open road #5135 across Deep Creek to private Weyerhauser Little Hoodoo Road #99468. The berm installed at the end of undetermined road #5135 during 2018 was breached by motorized vehicles during 2019. Just outside the BMU boundary, the previously impassable road #6203C was opened during 2018 and any portion located within the BMU moving window buffer would contribute to route densities within the BMU. This road remained open during bear year 2019. Please see the Cabinet Face BORZ discussion for additional information on road #6203C.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
3-Spar	No Change to OMRD (29%), TMRD (26%) or core (62%). At the end of BY 2019, BMU 3 is 3% less and better than its OMRD standard of 33%, meets its OMRD standard of 26%, and is 3% greater and better than its core standard of 59%. BMU 3 complies with its individual standards. No federal activities in this BMU that changed core or road densities. Based on visitor use records, the determination was made to include the Ross Creek Cedars Nature Trail as a high-use non-motorized trail which slightly decreased core acres by 183 acres, but did not change the percentage of core. Evidence of unauthorized motorized use behind gated road #404A contributed to OMRD but did not change the percentage. The restriction device was repaired.
4-Bull	No Change to TMRD (30%), OMRD (38%) or core (61%). At the end of BY 2019, BMU 4 remains 4% greater than its TMRD standard of 26%, remains 2% greater than its OMRD standard of 36%, and 2% less than its core standard of 63%. BMU4 does not meet its individual BMU standards. Additional database corrections due to continued development on private land resulted in a decrease of 282 acres of core and slight increases in OMRD route densities of > 1 mi/square mile and in TMRD route densities >2 mi/square mile but not enough to change the percentages. No federal activities occurred in this BMU that changed percentages of core or road densities.
5-St. Paul	No Change to percentages of OMRD (28%), TMRD (23%) or core (58%). At the end of BY 2019 BMU 5 is better (lower) than it OMRD standard of 30%, meets TMRD standard of 23%, and is 2% less (worse) than the core standard of 60 percent. BMU 5 does not comply with its individual core standard. Within the BMU, public breaches on gated FR roads 6212L (Little Cherry Loop L) and 6212M (Little Cherry Loop M) temporarily contributed to open route densities. Database updates to FR 5185 (S Bear Little Cherry)and 5181 (L Cherry Loop H Cowpatch) from open to their legal gated status and the county jurisdiction road #1408 Libby Creek bottom from open to gated contributed to decrease in open route densities, but did not change percentages. Outside of the BMU and within the Cabinet Face BORZ two changes contributed to changes within the BMU. FR 5193 (Swamp Ridge Units) went from open to barriered and resulted in a slight increase in core acres (23 acres) within the BMU, and the repair to the gate on FR 4776C (Horse Mtn Lookout C) contributed to a decrease in open route densities.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
6-Wanless	OMRD dropped 1% to 32%, TMRD remained at 34%, while core dropped 1% to 53%. BMU 6 is lower (better) than its 34% OMRD standard, and is 2% higher (worse) than its 32% TMRD standard and 2% less or worse than its 55% core standard. Several routes contributed to open route densities. Gated FR 4725 (North Fork Miller Cr) was considered open for the BY due to a damaged gate. In addition, the gate on FR 2314 (Corral Secondary Road), which was repaired and locked in September of 2018, was checked in October of 2019 and found again to have the lock cut and the gate opened. As a result FR 2314, and one of its spurs located within BMU 6 were considered opened for BY 2019. In BY 2018 it was inferred that all the associated spurs (FRs 2314M, 99808, 99809, 99809A, 99809B, 99809C, 99810) were located within BMU 6 when they are actually located within BMU 7. Please see BMU 7. All were considered opened for 2019. Decreases in route density resulted from BY 2018 breaches being repaired in fall of 2018 (gate repaired on FR 2332 and FR 5111) and from database updates on several routes. This included the update to code the entire FR 2332 (Bramlet Cr Road) as gated from the intersection with FR 231 (Libby Cr). This route is actually open on the ground until the gate located at the Trailhead parking lot. This database correction contributed to a slight decrease in open route densities for BY 2019 that did not reflect ground conditions and this will be corrected in the road layer for BY 2020. Two barriered routes being open during BY 2019 contributed to the 1% decrease in core. The berm on the Miller Creek / West Fisher Creek Road (FR 385) which was originally breached with ATV's in 2018 was not repaired in 2019, maintaining a 143 acre decrease in core for BY 2019. The Libby District is expected to repair this berm in Spring 2020 as soon as conditions allow. Also during BY 2019, road work associated with the Miller West Fisher Project opened a portion of the barriered segment of FR 4724 (S Fork Miller Cr) affecting 134 acres of core., As per the MWF 2009 BA, FEIS, and ROD, the Supplemental 2013 BA, and the MWF FSEIS and ROD 2017, this portion was to remain barriered during activity of the Miller West Fisher Project the and harvest of unit #26 (required winter harvest). This was not reflected in the 2009 engineering road package, which authorized brushing of the 4724 to the end of unit #26. . A barrier was not re-installed in 2019 after the road work. Libby District will re-install the barrier in the Spring of 2020 as soon as conditions allow. The route will be modeled as open until it is re-barriered.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
7-Silver Butte-Fisher	OMRD decreased by 5% to 24%. TMRD increased by 1% to 23%. No change in Core (65%). At the end of BY 2019, BMU 7 is 2% better (lower) than its OMRD standard (26%), is at TMRD standard (23%) and is 2% greater (better) than its core standard of 63% Contributing to a decrease in open route densities were the gates/locks being repaired in fall of 2018 on the Silver Butte Power Line Road (FR 594) on the Libby Ranger District and the Power Line Road (FR 2220) on the Cabinet Ranger District. On the Libby District, a breach on the main access road 2314 as described under BMU 6, extends into BMU 7 and it and its remaining spurs (FRs 2314M, 99808, 99809, 99809A, 99809B, 99809C, 99810) were considered opened for 2019. On the Cabinet Ranger District, barriers being placed on private roads previously open to public motorized use on Stimson land (Vermillion E Fisher 8834 and spurs 8834A, 8834B, and 8834C, 7593A, and portions of Vermillion Willow #8835, and all of #8835A) contributed to decrease in open and total route densities. Some of the changes (8834, 8834B, and 8834C) also resulted in slight increases in core acres. TMRD shows a 1% increase compared to BY 2018, but returns to 23%. TMRD remained at 23% from 2010 through 2017. An NRM coding error in 2018 resulted in the gated segment of FR 20 Odd 2211 not being considered. A correction in BY 2019 to NRM resulted the road again being considered as gated. This was not a change on the ground. This segment of FR 2211 remains gated at the intersection with the motorized trail FR 2211A 20 Odd ATV. No percentage change to core occurred but NRM database corrections and updates resulted in slight increases and decreases to core acres. The correction to FR 20 Odd 2211 resulted in a slight decrease of core acres that was shown in BY 2018, but 2019 reflects the core that has existed from 2010 through 2017 due to the gated segment of FR 20 Odd 2211 being included in the road layer. Another segment of FR 20 Odd 2211 was erroneously shown as open in BY 2018, but this segment of road is not drivable due to a washout and no motorized use on this segment occurs. This resulted in slight increase in core acres. Re-routing of portions of the motorized trail 20 Odd Peak #898 from private land to NFS land and county ownership also resulted in a slight decrease of core acres.
8-Vermillion	No change to OMRD (32%), TMRD at 22%, or core at 58%. At the end of BY 2019, BMU 8 complies with its 32% OMRD standard, is 3% above (better) than its 55% core standard, but is 1% greater (worse) and does not comply with its 21% TMRD standard. During BY 2019, on-the-ground verification of a user-created motorized trail near the Elk Lake hiking and motorized trail occurred and the route was digitized and added to the route layer. The additional user created motorized route contributed to open and total route densities and a slight decrease to core acres. The Spring Gulch Timber sale barriered previously gated roads FR2271 (Bear Creek), FR 2271A, and FR 38123. These changes also contributed towards improvements in total route density and core acres. Other NRM updates reflected corporate timberland owner Stimson installing berms on roads previously open to public motorized traffic after fire salvage. Berms placed on Vermillion East Fisher 8834 and its spurs 8834B, 8834C slightly increased core acres. For the bear year 2019 effort, NRM updates were made to ensure all the existing roads on the Lolo National Forest were accounted for and spatially correct within the KNF buffer. Lolo NF existing routes that have existed on the ground, but not previously considered in the KNF buffer include year-round open roads ManTrap FR 7562 and Stony Lake FR 7675, gated road WomanTrap FR 18467. Status and spatial location was also updated for gated road Vermillion Pass East FR 7680 and year-round open road Graves Vermilion FR 367. These were not changes on the ground, only a database updates. Considering these existing routes affected open and total route densities and core, but did not change the percentages. Other spatial corrections to the Lolo FR 7680 also slightly adjusted core acres but there was no change on the ground.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
9-Callahan	Correction for Bear Year 2018 monitoring report: In the BY 2018 report it was said there were no activities in this BMU that changed core or road densities. This was in error however, and did not account for the temporary 4% increase in OMRD from 27% (OMRD remained at 27% from Bear Year 2013 through BY 2017) to 31& in BY 2018. This temporary increase in BY18 was due to administrative use being exceeded on two gated roads: NFSR 4618 (Three Mile) and NFSR 1055: (North Fork Ruby Creek) for timber administration, and additional use by the Montana DNRC on NFSR 4618 for access to a State-owned section. This timber sale prep work was approved and analyzed under the Starry Goat Project. For Bear Year 2019, OMRD decreased 2 percent to 29%, TMRD increased 3 percent to 29%, and core decreased 2 percent to 57%. At the end of BY 2019, BMU 9 is 4% lower (better) than the OMRD standard of 33%, is 3% higher (worse) than the TMRD standard of 26%, and 2% better (higher) than the core standard of 55%. During 2019, administrative use of gated routes was not exceeded, including all gated roads analyzed and approved under the Starry Goat Project; access changes approved and analyzed under that project are temporary adjustments for project implementation. In-kind replacement of core and impacted core from project access occurred concurrently in Bear Year 2019. Temporally, the road storage work occurred first, and when this was completed, project approved routes that had been barriered were opened. The following roads were barriered for in-kind replacement of core: NFSRs 14373 and 4456. After securing replacement core, the following roads were opened for project access (new construction or barrier removed, and gate restricted): NFSRs 4405, 4418C, 4418D, 4455B, 1055F, 14377, 582, 582D, 582G, 4476D, and 414B. Unauthorized use occurred on two routes: NFSRs barriered road 427A (Callahan Creek A) and gated road 4479 (Blackbear). Use of these roads temporarily affected route density and/or core during Bear Year 2019. The State of Montana DNRC utilized NFSR 4479 to access a section of state-managed land, thus affecting open route densities. Also affecting route densities and core in 2019 were database updates (no change on the ground) to include the existing Burlington Northern Railroad tracks and access roads.
10-Pulpit	No change in percentage to OMRD (45%). TMRD increased by 2 percent to 28%. No change in core percentage (54%). BMU 10 is 1% greater (worse) than its OMRD standard of 44%, is 6% better (less than) its TMRD standard of 34%, and 2% better (higher) than its core standard (52%). The temporary increase in route density in BY 2019 is related primarily with ongoing, authorized activities associated with the OLY project (Oly Moly TS and some small sales). Slight improvements to core acres resulted from repairing BY 2018 breaches on NFSR 4690F (West Fork Quartz Creek F Road). Barriered NFSR 4433 had been breached and contributed to a temporary decrease in 360 acres of core and increase in route densities and was repaired in 2019. Therefore, it was considered open in BY 2019 and will be considered barriered going in to BY 2020. Database updates for the existing Burlington Northern Railroad tracks and associated railroad access routes, and existing Powerline access routes resulted in slight decreases to core acres and route densities.
11-Roderick	OMRD decreased by 1 percent to 29%. TMRD decreased 1 percent to 26%. Core increased 2% to 56%. During BY 2019, BMU 11 was worse than its OMRD standard of 28%, met its TMRD standard of 26%, and was 1% better (higher) than its core standard of 55%. Unauthorized access occurred on gated NFSRs 8021 and 6814A, however there is no indication administrative trip limits were exceeded. Nonetheless, we attributed the unauthorized use to a temporary increase in OMRD.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
12-Newton	OMRD temporarily increased 1 percent to 43%, No change to percentage of TMRD (32%) while core temporarily decreased 1 percent (54%). OMRD remained 2% better (lower) than its OMRD standard (45%), TMRD remained 1% higher than its standard of 31%, and core remained 1% lower (less) than its standard of 55%). Therefore, the BMU temporarily did not meet all standards during BY 2019. Emergency (fire) access occurred on two barriered roads in BY 2019: NFSR 2531 (Teepee Mountain) and NFSR 393 (Redtop Cyclone), but not the entire length of the affected segments. The access on NFSR 393 also occurred in adjacent BMU 13. Both route densities and core were temporarily affected. Unauthorized motorized use occurred on several routes (barriered NFSRs 14328 and 4438 which contributed to temporary increase in route densities; and impassable NFSR 2351D which temporarily decreased 32 acres of core and contributed to route densities). Emplacement of barriers on NFSR 749B and 749D as indicated in the Rocky Pine decision and NFSR 2379 as indicated in the MVUM will meet the direction of those decisions. All repairs to the above routes were completed by the fall of 2019. Because repairs were made in the active bear year, improvements to decreased route density and increased core will not be shown until BY 2020. These repair activities will bring the BMU to standards going in the BY 2020.
13-Keno	OMRD decreased 1 percent to 34%, TMRD decreased by 1 percent to 24%, and core remained at 59%. At the end of BY 2019, BMU13 remained 1% worse (above) than its standard for OMRD (33%), 2% better (lower) than its TMRD standard (26%), and met its core standard (59%). On the Kootenai NF, emplacement of barriers under the Buckhorn Project decision occurred in BY 2019 and will improve the TMRD and core conditions going into BY 2020. Barriers were placed on NFSRs 524 and 5971. In BY 2019, emergency (fire) use occurred on the barriered portion of NFSR 393 (RedTop Cyclone) to access a fire in BMU 12 to the south and temporarily affected core and route density. On the Kootenai NF, there was no unauthorized use or administrative use exceedance, and one route (NFSR 393) was used for emergency fire access. On the Idaho Panhandle NF, temporary project-related increases related to the Deer Creek Project. Most timber harvest within the BMU has been completed, but final road maintenance still needs to be completed. The BMU will comply with Forest Plan standards once the Deer Creek Project is completed.
14-NW Peaks	OMRD decreased 1% to 29%, and no change to TMRD (24%) or core (56%). At the end of BY 2019, BMU 14 was 2% lower (better) than its standards for OMRD (31%) and TMRD (26%), and 1% better (higher) than its core standard (55%). On the Kootenai NF, there was no unauthorized use, emergency access, or administrative use exceedance. No activities were reported for BY19 by the Idaho Panhandle Forest for their portion of this BMU.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
15-Garver	OMRD increased by 2 percent to 32%. TMRD remained at 27%, and core remained at 54%. BMU 15 was 1% better (lower) than the standard for OMRD, 1% greater (worse) than the standard for TMRD (26%), and 1% less (worse) than the standard for core (55%). The BMU did not comply within its individual standards for TMRD and Core in BY 2019. Unauthorized use occurred on the following NFSRs: 5853 (impassable) and 5856A (barriered) which temporarily affected both core and route densities; and 5890 (barriered, Gun Club; we list this as open anyway because of historic unauthorized use) which contributes to route densities. Database updates were made to reflect the continuing subdivisions and road construction on private land, as well as updates to the NFS road database. Construction of new roads on private land in several locations across the BMU and in the Yaak River valley contributes to the route density condition and decrease in core. Some improvements in condition resulted from reassessments of route conditions on NFS roads. Restriction devices were repaired during the fall on all unauthorized routes. Therefore, the BMU will be in compliance with the standards going in to BY 2020. No emergency access or administrative use limit exceedance on any routes beginning in this BMU.
16-East Fork Yaak	OMRD remained at 30% and TMRD at 25%, while core decreased 1 percent to 54%. For bear year 2019, BMU 16 was 3% better (lower) than its standard for OMRD of 33%, 1% better (lower) than its standard for TMRD (26%), and 1% less (worse) than its core standard of 55%. Unauthorized use occurred on the following NFSRs: barriered routes 746B, 6061, and gated route 6062. The breach on FR 6061 temporarily affected core and route densities while the breaches on 746B and 6062 temporarily affected route densities. Actual use was likely infrequent. All restrictions were repaired and will be considered barriered and gated going in to 2020. No emergency access or administrative use limit exceedance on any routes beginning in this BMU.
17-Big Creek	OMRD decreased 4% to 30%, TMRD decreased by 1% to 16%, and core increased 3 percent to 58%. For bear year 2019, BMU 17 was 3 percent better (lower) than its OMRD standard (33%), 11 percent better (lower) than its TMRD standard (26%) and 3 percent better (higher) than its core standard of 55%. Unauthorized access occurred on one route in BMU17: NFSRs 6061. NFSR 6061 access temporarily affected core (826 acres) in primarily BMU 16 and only incidentally affected BMU 17 core (13 acres). Actual use was likely infrequent and did not affect standards. No emergency access or administrative use limit exceedance on any routes beginning in this BMU.
18-Boulder	No percentage change to Core, TMRD, or OMRD. The temporary road used for Leonia TS beginning on restricted FSR 2111 was decommissioned in 2018, resulting in a small core increase and TMRD decrease. This road and the 2111 were counted as open for the decommissioning activity in 2018, but not 2019 (small OMRD decrease). Trip limits were exceeded for several miles of restricted FSR 1304 for timber sale prep. The portion of FSR 2260 within the neighboring Grouse BMU used for log haul activities associated with the Twentymile TS did not have haul activities in 2019 (small OMRD decrease). The end result is a small core increase/TMRD decrease from temp road decommissioning, and a small OMRD increase from FSR 1309 use offsetting lack of use of 2260 and 2111.

Bear Management Unit	Cabinet-Yaak Recovery Zone Management Actions
19-Grouse	OMRD decrease*, no change to Core or TMRD. *The IPNF identified four road systems in close proximity to NFS lands (that had been contributing to OMRD) actually had gates in place to restrict public access. Starting in 2019, the IPNF will model these roads as "restricted" and not count individual segments toward OMRD unless the landowner conducts active management (usually timber harvest) on the lands accessed by them. Including these closures reduces OMRD by several percent. The following factors influence OMRD in 2019 for the Grouse BMU: The portion of FSR 2260 within the Grouse BMU (5.2 miles) used for log haul activities associated with the Twentymile TS in 2018 was not hauled on in 2019. FSR 2260E (~1.1 miles) and 2260F (~1 mile) are still counting toward TMRD. Continued unauthorized ATV trail and use of a closed road in the South Fork Grouse area adding to OMRD and TMRD, and reduction in core. Under contract to be closed in 2020. FSR 215 exceeded administrative use trips in 2018 for wildfire suppression. This road was not used and reverted to restricted status for 2019 reporting. The gate restricting FSR 2260A was destroyed, leaving approximately 0.7 mile available to illegal use. Since this portion of road is scheduled for storage once post-harvest activities are complete, the gate has not been repaired. Private land logging required timber haul on the restricted portion of FSR 404 and approximately 2.2 miles of associated road on private land (one of the closures discussed in the * above). These roads were modeled as open for the 2019 Bear Year. The gate restricting FSR 2625 (another of the roads discussed in the * above) was left open by unknown parties and locked upon discovery in June. Additionally, there was evidence of ATVs circumventing the gate in previous years. The path around the gate was blocked in early summer, and it appeared that use behind the gate was very light despite the missing lock and illegal route around the gate for a portion of the season. Since it did not appear that illegal use exceeded trip limits, the road was modeled as restricted for 2019.
20-North Lightning	No Change. No activities in this BMU that changed core or road densities.
21-Scotchman	No percentage change to Core or TMRD, OMRD increase of 1%. Road building on private land resulted in an increase in OMRD, but changes to TMRD and Core did not result in a full percentage change.
22-Mt. Headley	In the last 2 years we have been preparing for our ongoing BMU 22 Compliance project to bring the BMU up to standard. The limited projects occurring in the BMU that affected roads (Copper King Fire salvage, 2018) moved toward standards in OMRD, TMRD, and core (See Copper King Fire Salvage BA). All other changes have resulted from intensive road/closure monitoring to insure correct data, and changes to roads on non-FS jurisdiction roads (Weyerhauser/State/Private). The amount of private timber company lands in the BMU, and the rate at which roads are constructed, blocked, and reconstructed is faster than we are able to record the data. Note – there is no data exchange between Private timber lands and USFS for road data, changes are either observed during on-the-ground surveys, or through examination of aerial photos, both of which do not cover the entire BMU at once. Note- several roads exceeding admin use requirements but those were consulted on in the Copper King Salvage BA, they are not listed below in the admin use table.

Note: On-going field validation of road status and road database cleanup may contribute to some change each year. Conditions on the ground do not necessarily change from the previous year.

Table 4. Management actions that resulted in changes to OMRD, TMRD or Core habitat from 2018 to 2019 in the Selkirk Recovery Zone on the Idaho Panhandle and Colville National Forests.

Bear Management Unit	Selkirk Recovery Zone Management Actions
Long-Smith	No percentage change to Core, OMRD increase, TMRD decrease. FSR 655 modeled as open to account for management of grazing allotments (same as previous years). A gate on private land in the upper Smith Creek drainage was destroyed in the recent past, and ATVs have been using several miles of the formerly restricted road. The ATV-able section of the road was modeled as open for the 2019 Bear Year. Conversations with the landowner about securing the closure are ongoing. There were several mapping errors from previous years that were discovered and corrected for the Bear Year 2019 reporting: • FSR 655 (Cow Creek) – the drivable portion of this restricted road extends approximately 1.3 miles further than previously modeled. • FSR 2443 (Cutoff Peak) - approximately 1.1 miles of stored road was mistakenly modeled as restricted. • Beaver Creek (upper Smith Creek) – approximately 0.3 mile of an unclassified road was modeled as open, but clearly has not been drivable for a very long time. The end result of these changes was an OMRD increase (due to use behind the damaged gate on private land), and small improvements to core and TMRD (additional miles of FSR 655 being outweighed by fewer miles elsewhere).
Ball-Trout	No Change. No activities in this BMU that changed core or road densities.

Bear Management Unit	Selkirk Recovery Zone Management Actions
Myrtle	No percentage change to OMRD; Core decrease, TMRD increase IPNF post-harvest activity (grapple piling) for Mini Mack TS exceeded trip limits on FSR 1309. A gated road in the upper Myrtle Creek drainage (Peak Creek) on private lands had been modeled as open in 2018 (fire suppression access) and 2017 (road reconstruction and logging). There were no activities behind this gate in 2019, and the road was modeled as restricted. A portion of restricted FSR 2400 on private land was used for log haul. Activities on private lands accessed by restricted FSR 2405 (Mack Creek) likely exceeded trip limits, and the road was modeled as open in 2019. A historic (non-motorized) trail on Apache Ridge has been accessed by OHVs in recent years from adjacent private and IDL lands. Vehicles have apparently been traveling nearly to the site of the former Roman Nose lookout (about 2 miles). A core deduction and OMRD/TMRD addition were taken in 2019. The route was shut off by the private landowner in fall, 2019. We will work with the landowner to ensure a permanent solution. There were also several mapping errors or changes from previous reporting that were discovered in 2019, and corrections made: • FSR 231 (Pack River) - approximately 0.5 miles of barriered (inaccessible) road was mistakenly modeled as open. • FSR 2566 (Snow Ridge) - approximately 0.7 miles of stored road was mistakenly modeled as restricted. • FSR 1309 the stored section of this road was found to be approximately 1/3 mile longer than previously reported. • FSR 2220 (upper Caribou Creek) – approximately 1 mile of road straddling IPNF and private lands behind a gate had been modeled as impassable, but showed evidence of having been used for private timber harvest several years ago, and is officially restricted in the INFRA database. Road is now modeled as restricted. • Several new or reconstructed road systems on private lands off West Side Road on the extreme east end of the BMU were added upon discovery. Core decreased and TMRD/OMRD increased as a result of the Apache Ridge trail use and newly discovered roads on private lands. Other changes discussed above effectively canceled out changes to OMRD (no percentage change).
Lakeshore	No Change. No activities in this BMU that changed core or road densities.
Kalispell - Granite	No change in TMRD or Core, OMRD increase of 3%. The 311A network of roads on Hancock land were considered open for the MW analysis. Hancock conducted logging activity on their land during the summer and fall bear seasons in 2019. 3.2 miles of FSR 311 that provide access to the Hancock land was also considered open for analysis. Multiple private roads off of FSR 308 on Stimson land in sections 5 and 9 were considered open due to logging activity. The network of private roads off of FSR 311 in section 3 on Stimson land were considered closed for analysis, as reported use on these roads did not exceed allowable limits in 2019. In all these changes resulted in a 3% increase in OMRD. In late August gates were violated on the north and south end of FSR 311. The gates were open for only 5 days. During the summer season there were only 7 administrative use trips taken on the 311 road. It is unlikely that more than 16 additional trips were taken during the 5 day window that the gates were open, so the section of 311 south from the junction of 311A was modeled as restricted. FSR 401, FSR1341, FSR1015 and FSR1362H were analyzed as open roads since they are always open during a portion of July, August and September (same as previous years).
Salmo-Priest	In 2019 there were no activities in this BMU that resulted in a change to Core Habitat or road densities

Bear Management Unit	Selkirk Recovery Zone Management Actions
Sullivan-Hughes	No change to OMRD, TMRD or Core. In the fall of 2019 the CNF completed Phase 1 of the Sullivan Creek Large Woody Debris Enhancement Project. Trees were felled in a timber stand located adjacent to Forest Road 2200394 and stockpiled on site. These trees were then flown by helicopter to locations in nearby Sullivan Creek. The pilot carefully placed the log pieces in an interlocking fashion at 8 pre-selected sites on the creek. The intent was to improve in-stream habitats for fish and other aquatic organisms. Aerial operations occurred over a 7 consecutive day period in the month of October. Helicopter use occurred outside the critical spring period for bears and was confined to flights directly over open road corridors, in order to avoid impacts to core habitat.
Blue Grass	OMRD decrease, no percentage change to Core or TMRD Route used by Continental Mine owners to their inholding in Blue Joe Creek modeled as open, including FSR 1009, 636, 1011 and 2546. Vehicular use likely to have exceeded administrative use limits. Numerous dump trucks traversed FSR 1009 and FSR 636 accessing gravel pits to haul fill for repairs on FSR 2455 adjacent to Saddle Creek. Both 1009 (discussed above) and the southern approximately 3 miles of FSR 636 modeled as open. FR1388 gate 117 (Lime Creek) was monitored with a camera and traffic counter. No evidence of illegal ATV use in 2019. Road modeled as restricted (open in 2018). OMRD decrease from this change more than offsets increase from FSR 636 use.
LeClerc	In 2019 there was a 3 percent increase in OMRD, no change to TMRD in this BMU. Decrease in Core (no percentage change). In the fall of 2019 the Colville NF completed the West Branch LeClerc Creek Stream Restoration Project in this BMU. For this project, a helicopter was used to fly cut trees from a stockpile area to locations on the creek between the old Diamond City Mill site and Forest Road 1935 where it crosses the creek. The pilot carefully placed log pieces in an interlocking fashion at 42 pre-selected sites in the creek. Because the project required helicopter use over an area of core habitat, it resulted in a short-term (3 day) reduction in core (less than 1 percent of the total core area in the BMU). Seco Sorts Timber Sale (WADNR) was active from July 22 to December 11 in the Fourth of July Peak area. This caused us to class the Seco Creek Road (FR 1934070) as active (open) in 2019. Stimson Lumber Company timber sales caused us to class 6 restricted road segments as active (open) in 2019.

Note: On-going field validation of road status and road database cleanup may contribute to some change each year. Conditions on the ground do not necessarily change from the previous year.

Seasonal Administrative Use

During the 2019 bear year in the Cabinet-Yaak and Selkirk Recovery Zones, there were some instances where administrative vehicle entries on restricted access roads exceeded standards. Restricted roads that received administrative use in excess of the allowable trips (either seasonally or over the entire bear year) were considered "open" roads for the purpose of calculating OMRD for 2019. Additional instances of public trespass behind closed gates were documented in several BMUs, but the level of use could not be determined. Other barriered roads may have been breached. Where those situations were known, those roads were considered to be "open" for the purposes of calculating OMRD, TMRD, and core acres above, but are not considered "administrative use".

Tables 5 and 6 summarize seasonal administrative use on restricted roads by BMU over the 2019 bear year. Unauthorized use by the public (breached roads) is not considered administrative use in the tables.

Table 5. Seasonal administrative use within the Cabinet-Yaak Recovery Zone by bear management unit (BMU) in 2019.

Bear Management Unit	Number of Restricted Roads With Administrative Use During Bear Year 2019	Number of Restricted Roads Exceeding Seasonal and Total Administrative Use Levels During "Bear Year" 2019			
		Spring Use Period 4/1-6/15 (≥18 trips)	Summer Use Period 6/16-9/15 (≥23 trips)	Fall Use Period 9/16-11/30 (≥19 trips)	**Total Use** 4/1-11/30 (≥60 trips)
1-Cedar[1]	6	0	1	0	0
2-Snowshoe	3	0	0	0	0
3-Spar	4	0	0	0	0
4-Bull	1	0	0	0	0
5-St. Paul	8	0	0	0	0
6-Wanless	7	0	0	0	0
7-Silver Butte-Fisher	2	0	0	0	0
8-Vermillion	2	0	0	0	0
9-Callahan	9	0	0	0	0
10-Pulpit	7	0	0	0	0
11-Roderick	4	0	0	0	0
12-Newton[2]	10	0	2	0	2
13-Keno[3]	1	0	1	0	1
14-NW Peaks	8	0	0	0	0
15-Garver	5	0	0	0	0
16-East Fork Yaak[4]	5	1	1	1	1
17-Big Creek	0	0	0	0	0
18-Boulder[5]	7	0	1	0	1
19-Grouse[5]	6	0	3	0	3
20 -North Lightning	0	0	0	0	0
21-Scotchman	0	0	0	0	0
22-Mount Headley	2	0	0	0	0
Total	**97**	**1**	**8**	**1**	**7**

[1] BMU 1 – Libby RD administrative use exceeded on FR 4729E – accessed via gate on FR 4729, exceeded allowable use levels during summer. Use of FR 4729E was modeled as open for the Flower Creek Project for sale prep activities. Public use did not occur.

[2] BMU 12 – Three Rivers RD emergency (fire) access occurred on two barriered roads in BY 2019: FR 2531 (Teepee Mountain) and FR 393 (Redtop Cyclone), but not the entire length of the affected segments. Access on NFSR 393 also occurred in adjacent BMU 13.

[3] BMU 13- Three Rivers RD emergency (fire) use occurred on the barriered portion of FR 393 (RedTop Cyclone) to access a fire in BMU 12 to the south and temporarily affected core and route density.

[4] BMU 16 – Ksanka (aka Rexford) RD -FR 999 Plum Bob considered open for "Young Fork" timber sale activities, administrative use only. Activities approved under Caribou Fire Salvage Project. So one road that exceeded administrative use accessing BMU 16.

[6] BMU 18 and 19 – Idaho Panhandle NF – both BMUs include FR 2260

[7]BMU 22 – Copper King Salvage Timber Sale, carried into 2019 and used several roads associated with FS 894, and FS 875. These roads were accounted for as open in the Project BA. Note, admin use reporting (for 2020) was discussed with the district on 3/23/20 (staff meeting) and on 4/15/20 (email to entire district).

During Bear Year 2019 in the SRZ, there were some instances where administrative use levels exceeded allowable seasonal use levels (Table 6). Roads that experienced administrative use in

excess of the allowable trips—either seasonally or for the entire bear year—were considered “open” when determining the existing condition displayed in Table 1.

Table 6. Seasonal administrative use within the Selkirk Recovery Zone by bear management unit in 2019. Once roads exceeded allowable round trips, they were considered “open” for analysis purposes for the remainder of the bear year.

Bear Management Unit	Number of Restricted Roads with Administrative Use During Bear Year 2019	Number of Restricted Roads Exceeding Administrative Use Levels During “Bear Year” 2019			
		Spring 4/1-6/15 (≥19 round trips)	**Summer** 6/16-9/15 (≥23 round trips)	**Fall** 9/16-11/15 (≥15 round trips)	**Total Use** 4/1-11/15 (≥57 round trips)
Blue Grass[1]	7	0	2	1	2
Long Smith	1	0	1	0	1
Kalispell Granite	5	0	1	2	1
Salmo Priest[2]	7	0	0	0	0
Sullivan Hughes[2]	6	0	0	0	0
Myrtle	4	0	2	0	2
Ball Trout	1	0	0	0	0
LeClerc[3]	23	0	1	6	6
Lakeshore	0	0	0	0	0
Total	**54**	**0**	**7**	**9**	**12**

[1] Forest Roads 1009, 636, 1011 and 2546 form essentially one route to access a private inholding. These routes are also used extensively by the Border Patrol.
[2] All restricted road use on the Idaho Panhandle NF was reported to Colville NF, who reported figures for both forests.
[3] Stimson Lumber Company administrative entries and timber sales (FR 1934080, 1934200, 1935011, 1935024) and Colville NF in-stream habitat work on FR 1933110

Road Closure Monitoring

The Forest Service monitors closed roads in the recovery zones as time and budgets allow. Agency personnel attempt to repair or replace any vandalized gates and locks as soon as possible. Where road closures have been driven around, steps are taken to block this illegal access as soon as possible using boulders, earthen berms, cement posts, plantings, root wads, or other means. Beginning in 2012, the forests were required to ensure that at least 30 percent of all gates and barriers within the recovery zones were monitored annually (USDI 2011). Tables 7 and 8 display the numbers of gated and barriered roads that were monitored during the 2019 bear year.

Table 7. Summary of closed road monitoring within the Cabinet-Yaak Recovery Zone in 2019. Data on file at the district offices.

Grizzly Bear Recovery Zone	**National Forest**	**Closure Type**	**2019**		
			Number of Closure Devices	**Number Monitored**	**Percent Monitored**
Cabinet-Yaak	**Idaho Panhandle**	Gate	54	51	94
		Barrier	33	0	0
		Total	**87**	**51**	**59**
	Kootenai[1]	Gate	268	202	75
		Barrier	663	417	63
		Total	**931**	**619**	**66**
	Lolo	Gate	82	24	20
		Total	**197**	**40**	**27**
Recovery Zone Total			**1,215**	**710**	**58**

[1] As of 2019, the total number of devices has been updated to reflect conditions on the ground due to data collected during 2018 and 2019 on the Libby RD. This has further refined the number of impassible roads (due to vegetation) that actually had a barrier in place. On the Rexford RD slight adjustments were made for a gated road that was bermed. On the Three Rivers RD due to ongoing approved project activities, including creation of in-kind-core and harvest and watershed improvement work, barriers have been installed on roads previously impassible due to vegetation, or previously gated roads, while some previously barriered roads are now gated, and the total number of closure devices and the number of routes being gated, barriered, or impassible due to vegetation have fluctuated over time, and this is true for 2019.

Table 8. Summary of closed road monitoring within the Selkirk Recovery Zone in 2019. Data on file at the district offices.

Grizzly Bear Recovery Zone	National Forest	Closure Type	2019		
			Number of Closure Devices	Number Monitored	Percent Monitored
Selkirk	Colville	Gate or Guardrail	73	58	79
		Impassable	50	43	86
		Total	**123**	**101**	**82**
	Idaho Panhandle	Gate or Guardrail	87	74	85
		Barrier	27	0	0
		Total	**114**	**74**	**65**
Recovery Zone Total			**237**	**175**	**74**

In 2019, a total of 58 percent and 74 percent of all gates and barriers were monitored in the Cabinet-Yaak and Selkirk Ecosystems, respectively.

Table 9 lists the ongoing locations, dates, duration, and circumstances for invoking the allowance for entering core area for the purposes of road decommissioning or stabilizations in the Cabinet-Yaak Recovery Zone.

Table 9. List of ongoing locations, dates, duration, and circumstances for invoking the allowance for entering core area for the purposes of road decommissioning or stabilizations in the Cabinet-Yaak Recovery Zone.

BMU	Location	Date	Duration	Circumstances
1-Cedar	Southwestern corner of the BMU in the Madge Creek area.	Summer 2017	~ 2 wks	Combination of storage and decommissioning of roads 691, 691E, and 14705, Sparring Bulls Project
9-Callahan	In finger of core between north and south Callahan creeks, east of Smith Patrol (mountain).	July-16-August 10, 2012	~3 ½ wks	Road 4521 – combination of decommissioning and storage work under West Troy Project

Bears Outside Recovery Zones (BORZ)

There are seven discrete areas of recurring grizzly bear use within proximity to the Selkirk and Cabinet-Yaak Recovery Zones (Allen 2011). These areas are referred to as Bears Outside Recovery Zones (BORZ). According to the forest plan amendments signed in November of 2011, the forests are required to ensure "no permanent increases in the total linear miles of "open roads" and "total roads" above baseline conditions on National Forest System lands in any individual BORZ area, except in cases where the Forest Service lacks discretion to prevent road building across National Forest System lands due to legal or other obligations (USDA Forest Service 2011; USDI Fish and Wildlife Service 2011). Any potential increases in linear miles of open or total roads must be compensated for with in-kind reductions concurrently or prior to such increases (ibid).

Table 10 displays the size, land ownership, and linear miles of open and total roads for the BORZ areas as of 2019. Recurring Use Areas (RUA's) added since 2011 are displayed as individual RUA's and as combined with the existing adjacent BORZ.

Table 10. Bear Year 2019 motorized access conditions for Bears Outside of Recovery Zones (BORZ) areas and additional areas identified as Recurring Use Areas (RUA's| since 2011.

Bears Outside Recovery Zone And RUA's	Grizzly Bear Recovery Zone	National Forest	Total Size (Acres)	National Forest System Lands		
				Total Area NFS (Acres)	Total Routes (Miles) Baseline/**2019**	Open Routes (Miles) Baseline/**2019**
Priest Lake	Selkirk	IPNF	80,733	75,793	319.2 (373.3)	317.2 (373.3)
Pack River	Selkirk	IPNF	33,869	28,097	41.9 (37.7)	37.9 (34.9)
Caribou-Snow RUA	Selkirk	IPNF	10,603	10,603	14.2/14.2	11.3/11.3
Mission- Moyie	Cabinet-Yaak	IPNF	71,545	58,472	200.3/243.6[1]	167.3/213.6[1]
Mission-Moyie II RUA	Cabinet-Yaak	IPNF	28,530	28,530	102.1/102.1[2]	100.1/100.1[2]
Mission-Moyie III RUA	Cabinet-Yaak	IPNF	3,631	3,631	25.5/25.5	25.2/25.2
Cabinet Face [3]	Cabinet-Yaak	KNF	28,052	27,083	165.0 (166.2)	133.6 (134.7)
Clark Fork[4]	Cabinet-Yaak	KNF	101,899	100,209	267.4 (257.4)	186.4 (185.0)
2011 West Kootenai[5]	Cabinet-Yaak	KNF	173,318	169,693	616.8 (608.6)	331.6 (336.4)
Bobtail RUA[6]	Cabinet-Yaak	KNF	13,975	10,189	44.6 (45.5)	29.1 (31.4)
Cedar Cr-Kootenai River RU A[7]	Cabinet-Yaak	KNF	19,039	14,498	44.6 (45.5)	32.4 (33.3)
Lower Pipe RUA [8]	Cabinet-Yaak	KNF	11,263	6,175	87.5 (87.5)	63.8 (63.8)
West Kootenai and RUA's [9]	Cabinet-Yaak	KNF	217,595	200,555	790.1 (785.3)	456.9 (464.9)
Tobacco [10]	Cabinet-Yaak	KNF	287,240	266,992	1,192.7 (1,204.9)	936.4 (976.9)

"Baseline: See USDA FS 2012, BY 2011 Table 9, footnote #2, stating 2011 AA ROD baseline numbers represents the 2010 existing condition identified in the amendments to the Forest Plan (USDA Forest Service 2011) and incorporated into the KNF Forest Plan (USDA Forest Service 2015).

[1] **Mission-Moyie** - 2010 open/total roads + 50.5 motorized trail miles (previously not reported) + 4.4 mi railroad miles (previously not reported).

[2] **Mission-Moyie II RUA** - 2016 open/total roads + 16.7 motorized trail miles (previously not reported). No railroad miles in this RUA.

[3] **Cabinet Face BORZ –** No existing railroad tracks, or railroad or powerline access routes within this BORZ boundary

[4] **Clark Fork BORZ:** The KNF updated the database for total routes from 256.1 miles to 267.4 miles to account for 1.84 miles of gated Avista Powerline Access, plus 9.5 miles of existing routes not previously reported (1.7 miles of railroad tracks, 0.1 miles of Railroad access roads and 7.7 miles of powerline access). The KNF updated the database for open routes from 176.9 miles to 186.4 miles to account for the 9.5 miles of existing routes not previously reported. The 9.5 miles are existing routes and not a change on the ground.

[5] **2011 West Kootenai BORZ:** Numbers displayed in Table 10 reflect the 2011 AA acreages and updates to the database that have been reported in the Bear Year monitoring reports, and separated out for just what occurred within the 2011 AA boundary. The KNF updated the database for total routes from 331.5 to 331.6 miles with a database correction & update of 0.08 miles on FR 4604 from gated to open. No change occurred on the ground. No existing railroad tracks, railroad or powerline access routes occur within the 2011 boundary.

[6] **Bobtail RUA:** The Bobtail RUA was analyzed as an addition to the West Kootenai BORZ from 2012 through 2018. For BY 2019 it is shown as a separate RUA. In BY 2019 the KNF updated the database for total routes from 40.5 miles to 41.2 miles to account for 0.7 miles of existing powerline access routes not previously reported. The 0.7 miles of power line access route is existing and no change on the ground. The KNF updated the database for open routes from 28.2 miles to 29.1 miles to include the 0.7 miles of existing powerline route not previously reported and database updates on FR 6144D (0.1 mi) and FR 4698A (0.1 mi) (no change on the ground).

[7] **Cedar Creek- Kootenai River RUA:** The existing condition established in 2019 for this new RUA are 44.6 miles of total routes (33.1 total miles of KNF roads and 11.5 miles of other routes (consisting of 9.1 miles of long-term illegal user-created routes, 0.8 miles of railroad tracks, and 1.6 miles of existing powerline access routes). Existing condition for open routes are established at 32.4 miles (20.9 miles of open KNF roads and the 11.5 miles of other routes described for total routes).

[8] **Lower Pipe RUA**: The existing condition established in 2019 for this new RUA are 87.5 miles of total routes (86.4 miles of total KNF roads and 1.1 miles of long-term illegal user-created routes). Existing condition for open Routes are established at 63.8 miles (62.7 miles of open KNF roads, and 1.1 miles of illegal user-created routes. No existing railroad tracks or powerline access routes exist.

[9] **West Kootenai BORZ 2019 (2011 boundary with the expansion of Bobtail, Cedar Creek-Kootenai River and Lower Pipe RUAs) - T**he updated combined 2019 West Kootenai BORZ database established for total routes is 790.1 miles and open routes is 456.9 miles.

[10] **Tobacco BORZ:** For BY 2019, the KNF updated the database for total routes from 1,127.4 miles to 1,192.7 miles. This increase reflects database corrections on 1.4 miles of KNF routes (either ANILCA or corrections to database and no change on ground), and updates for 63.9 miles of existing routes not previously recorded (22.4 miles of existing railroad tracks, 2.9 miles of railroad access roads, 26.9 miles of railroad dozerbladed firelines, and 11.7 miles of powerline access routes). The KNF updated the database for open routes from 872.0 miles to 936. 4 miles. This increase reflects database updates on 0.5 miles of KNF routes (ANILCA access) and the database updates for 63.9 miles of existing routes not previously recorded as described for total roads. The 63.9 miles are existing routes and no change occurred on the ground.

Priest Lake BORZ

Total roads in the Priest BORZ have increased to 373.3 miles, and open roads have increased to 373.3 miles. These increases reflect unauthorized use and GIS inaccuracies identified by direct monitoring within the BORZ, IGBC coding that did not accurately represent road status as defined by the 2015 Kaniksu Zone IPNF Motor Vehicle Use Map, as well as the addition of motorized trails not previously reported.

As part of the Hanna Flats Project, 30.7 miles of road will be secured against unauthorized motorized use by various methods. Some of this work was completed in the fall of 2019, the remainder to be implemented in spring of 2020. The IPNF will continue to identify additional unauthorized use and will take steps to curtail any use found as well as make any database corrections needed.

There are approximately 20.7 miles of existing linear motorized trail miles that have been in place since 2010, but not accounted for in the 2010 BORZ baseline. Previously the IPNF excluded motorized trails from the baseline and annual condition reporting using the IGBC and Access Amendment definition of roads: "All created or evolved routes that are greater than 500 feet long (minimum inventory standard for the Forest Service Route Management System), which are *reasonably and prudently drivable with a conventional passenger car or pickup*." In an effort to: 1) maintain consistency calculating linear route miles across Forests; 2) acknowledge the potential biological impacts of ALL motorized use on grizzly bears; and 3) adhere to the 1998 IGBC direction related to quantifying motorized access effects on grizzly bears in recovery zones and the apparent intent of the 2010 BA and 2011 FEIS; ALL motorized routes (roads and trails) will now be included in the environmental baseline.

Pack River BORZ

A few corrections were made to bring the Pack River BORZ 2019 condition up to date:

- A 0.4 mi segment of FSR 2558 was incorrectly classified as closed yearlong, and was previously counted in the total miles for the BORZ. It is in fact open, and that mileage has been added to the open road miles. An additional 0.3 miles of FSR 2558 was not counted at all, but is an open road.
- FSR 2558B (0.9 miles) was counted in total road miles, but appears undrivable.
- FSR 776UA (Middle Pack River) provides access to private lands, and has been added as an open road (0.4 miles).
- FSR 239UI showed signs of ATV use, so that 0.3 mi segment was included in the open road miles.

These changes increase open road miles to 34.9, and decrease total linear road miles to 37.7 from those reported for the 2018 Bear Year (compared to the original 2010 baseline of 37.9 and 41.9 miles, respectively).

Motorized trails: There are 10.2 miles of motorized trails in the Pack River BORZ. This includes approximately 0.9 miles of converted road 2558 that was previously included in total road miles. These trails have been in place and unchanged since prior to 2010.

2019 addition ("Caribou-Snow RUA"): after of review of verified grizzly bear sightings, it was determined that the Caribou Creek/Deep Creek watershed would be added to the BORZ area. Additionally, small portions of Snow Creek and Myrtle Creek watersheds – completely surrounded by either the Myrtle BMU or the new BORZ addition – would be added as well. The West Side RUA totals approximately 10,603 acres and contains 11.3 miles of open roads, and 14.2 miles of total roads (there are no motorized trails or railroads in this area).

Mission-Moyie BORZ

The condition of the Mission-Moyie BORZ area is essentially unchanged since 2018. However, in order to better demonstrate consistency with Forest Plan standards, conditions are reported separately for the original (2011) BORZ polygon and the 2016 expansion polygon. Additionally, motorized trails and railroads have not been reported for this BORZ in past reports, but are being reported for 2019.

The 2011 BORZ polygon currently contains 155.3 miles of open roads, and 185.2 miles of total roads (compared to 167.3 open miles and 200.3 total miles reported in 2011). This area also contains 54.0 miles of motorized trail, compared to 50.5 miles of motorized trail in the area in 2011. The additional 3.5 miles of trail are a result of relocation of trail 225 (adding approximately 1 mile) and road-to-trail conversions adding miles to trails 32 and 415 (and concurrently reducing open road miles). The BORZ also contains 4.4 miles of railroads (unchanged since 2011).

The expanded (2016) area contains 83.4 miles of open road, 85.4 miles of total road, and 16.7 miles of motorized trail. These values are unchanged since 2016.

The combined areas contain 238.7 miles of open roads and 270.6 miles of total roads (plus 70.7 miles of motorized trail), compared to 239.7 miles open roads and 271.7 miles of total roads reported in 2018. The loss of approximately one mile of road is due to small database corrections.

Since 2016, additional observations from multiple bears (including an adult female) have been documented adjacent to the CYRZ, south of the 2016 BORZ addition. Observations were documented in the Skin Creek-Moyie River, Dobson Creek-Kootenai River, Sand Creek-Kootenai River, and Curley Creek subwatersheds. It is recommended that the following portions of these be incorporated into the BORZ area: NFS lands north of the Kootenai River (lands south of the Kootenai are within the CYRZ), and east of the Moyie River (for similar reasons discussed in 2016). This adds approximately 3,631 acres to the BORZ area. In 2019, there were 25.2 miles of open roads, and 25.5 miles of total roads within this area. There are no railroads or motorized trails in the 2019 addition.

Cabinet-Face BORZ

The KNF access amendment (AA) baseline for total and open linear miles of roads for the Cabinet Face BORZ did not account for existing railroads or railroad access routes or existing powerline access routes. Currently none are identified within the boundaries of the Cabinet Face BORZ.

Contributing to the BY 2019 linear miles of total road temporarily being over the total road database are impassible road FR 5045A Schreiber Jump up A (0.17 miles), barriered FR 5095 Lower Deep Creek (0.44 mi), and the FRTA authorized gated FR 4400C (0.39 miles) being open in bear year 2019. As described in BY17 report, a temporary increase in linear miles resulting from temporary road construction (0.4 miles) at the end of 4400C Hoodoo Creek C (North Swamp FRTA) to access Weyerhauser land, and set to be barriered post use. In BY18 report it was clarified that the segment remained gated during 2018, and that Weyerhauser anticipated leaving the road gated through BY19, with the 0.4 miles on NFS land still scheduled to be bermed following Weyerhaeuser's activity on their land. During BY19, the gate was found to be missing when inspected on 10/15/2019 and currently due to the seasonal restriction on 4400C, the 0.4 miles on NFS is also seasonally restricted. The district will determine in 2020 when the 0.4 miles will be barriered per the FRTA in 2020.

Contributing to the BY 2019 linear miles of open road being temporarily over the open database include FR 5174 Getner Creek A unit (0.2 mi), FR 4400C, 5045A, and 5095. In addition, the 6203C, a road opened in 2018 due to discrepancy in MVUM was re-barriered in 2019, and this reduction will be reflected in 2020. Other database updates and corrections slightly adjusted the bear year total and open linear miles of routes.

Clark Fork BORZ

The Forest ownership GIS layers calculates the federal ownership in the Clark Fork BORZ at 100,209 acres and this is reported in the BY 2019 report, It has been determined clerical error resulted in the AA reporting 100,421 acres. The boundary of the Clark Fork BORZ has not changed since being established in the Access Amendment. No change occurred on the ground.

The KNF AA baseline total and open linear miles of routes did not account for existing railroads or railroad access routes or existing powerline access routes within the Clark Fork BORZ. Previously reported bear year mileages also did not account for these routes. The 9.5 miles are existing routes and not a change on the ground. The KNF has no authority over the existing routes documented in 2019 due to easements or other agreements.

As documented in BY 2017, a barriered road #14622 (0.35 miles) was opened by Avista Corporation to access a power pole, and in BY 2018, the route was gated. In addition in BY 2019, Avisita opened two previously bermed NFSR routes #1944 (0.81 miles) and #2229N (0.68) for access to their powerline, and installed two gates. An additional two gates are planned to be installed in 2020 to effectively restrict the roads, so both were modeled as open for 2019.

In BY 2019 the KNF updated the database and reset existing conditions for total routes from 256.1 miles to 267.4 miles to reflect updates and corrections. These include FR 14622, FR 1944, and FR 2229N that will be managed as gated for Avista powerline access, plus 9.5 miles of routes not previously recorded (consisting of 1.7 miles of railroad tracks and 0.1 miles railroad access roads and 7.7 miles of powerline access routes).

In BY 2019, the KNF updated the database and reset existing conditions for open routes from 176.9 miles to 186.4 miles to account for the 9.5 miles of routes not previously recorded.

A discrepancy for a road has been recently found in the NRM layer by the Kootenai Forest Transportation Engineer during a review with the IPNF. The mileage of this route, which crosses back and forth across the KNF and IPNF forest boundaries, is not reflected in the 2019 adjusted existing conditions as the database error was found after the BY 2019 calculations were completed. This route is identified in the KNF database as NFSR 3332A and was coded as impassible in the 2010

existing condition, and has remained coded as impassible. However the route is under the Idaho Panhandle National Forest jurisdiction and management where it is identified as NFSR 332A and the route is an open road, and has been an existing open road since before 2010. The KNF MVUM map also identifies the route as year-round open because the IPNF database was used to generate this portion of the MVUM. The database correction in the KNF NRM from impassible to open and the effect to the Clark Fork total and open database will be reflected in the Bear Year 2020 report. This will be a database correction, no change will have occurred on the ground.

Contributing to temporary increases during BY 2019 were 1.1 miles of unauthorized user created motorized routes. In error, an additional existing 0.2 miles of user created routes near Triangle Pond were omitted from the BY 2019 route layer and are not reflected in the BY 2019 mileages displayed in Table 10. If these routes had been included in the BY19 road layer the bear year 2019 total routes would have increased to 257.6 miles, and BY 2019 open routes to 185.2 miles. Both bear year 2019 total and total open miles, and would remain below, and better than the updated 2019 reset existing condition. The Cabinet Ranger District is in the process of addressing these 0.2 miles. The Triangle Pond Day-Use Area Project proposes that three barriers will be installed to prevent use of a 720-foot (0.14 miles) unauthorized motorized route and a short connector (0.02) between the shoreline and the NFSR 2234. On the ground work is expected to be implemented in 2020.

No breaches of legally restricted routes were documented in BY 2019.

West Kootenai BORZ (2011 Boundary)

The condition of the West Kootenai BORZ area is essentially unchanged since 2018. However, in order to better demonstrate consistency with Forest Plan standards, conditions are reported separately for the original (2011) BORZ polygon, the 2012 expansion with the Bobtail RUA, and the 2019 expansions with the Cedar Creek-Kootenai River RUA, and the Lower Pipe RUA.

No existing railroad tracks, railroad or powerline access routes occur within the 2011 boundary of the West Kootenai BORZ.

Within the West Kootenai BORZ 2011 boundary, the KNF updated the database and reset existing conditions for total routes from 331.5 miles to 331.6 miles for database corrections and updates. FR 4604 (0.08 miles) was updated to an existing open road due to more accurate mapping, no change occurred on the ground. FR92Z was updated to a gated road, it was identified in the 2010 AA baseline as a gated road but in 2011 it was incorrectly coded as barriered due to clerical error. This route has always been gated. BY 2019 total reflects this update.

Also contributing to a temporary increase in total roads were previously barriered or impassible routes being used for timber sale projects (under the Caribou or West Fork Fire Salvage projects (FRs 7197, 7164B, 7168F, 7164A, 7173C, 4613E, 4613F, 4613G, 6145, 754 and 754 temp). In addition, temporary breaches on gated FRs 4851, 8000L, 751, 4724E, 863 and barriered FR 309Z contributed to the temporary increase.

To better demonstrate consistency with Forest Plan standards, conditions are reported separately for the original (2011) West Kootenai BORZ polygon, the 2012 Bobtail RUA expansion polygon, and the 2019 expansion polygons for Cedar Creek – Kootenai River RUA and Lower Pipe RUA.

Conditions are also reported for the 2019 combined West Kootenai BORZ with the original 2011 boundary and all additional RUAs

Bobtail RUA

The Bobtail RUA was analyzed as an addition to the West Kootenai BORZ from 2012 through 2018. For BY 2019 it is also shown as a separate RUA. The Bobtail RUA database for total and open linear miles of routes did not account for existing railroads or railroad access routes, or existing powerline access routes. Previously reported bear year mileages did not account for these routes. For BY 2019, 0.7 miles of existing open routes associated with the Bonneville Power line for access and

maintenance were documented. This is an existing route and no change on the ground. The KNF has no authority over this route due to easements or other agreements.

The KNF updated the database and reset existing conditions for total linear routes from 40.5 miles to 41.2 miles to account for 0.7 miles of powerline access route not previously reported. During BY 2019 total roads of 43.7 miles temporarily exceeded the baseline of 41.2 miles due to an unauthorized user-created motorized trail (1.2 miles) and that the FR 5090 (1.3 miles) continued to be gated while the D5 engineers determined drainage work. Installation of a barrier on the user-created route is anticipated to be completed in 2020. FR 5090 Bobtail Valley (1.3 miles) when the Bobtail RUA was established, was a barriered road with legally no administrative motorized use (it had been placed into intermittent stored service and closed with an earthern berm in 1999). As reported in the bear year 2017 report, there was a temporary increase in total and open linear miles of roads due to impassable road #5090 (1.33 mi) being opened for fire (dozer/machine line) and not restricted again due to log decks remaining on the road. The route was then utilized for the West Fork Fire salvage and was considered opened through BY18 due to public use, although a temporary gate was installed. During BY19, the road remained gated. Timber harvest was completed in January of 2019, and most of the storage work by the purchaser was completed in 2019, but work was not completed during 2019 as the Libby District Engineers had not yet decided on the drainage work on a segment of the road. The road remained gated during bear year 2019 and work is expected to be completed in 2020 with the berm replaced.

The KNF updated the database and reset existing conditions for open routes from 28.2 miles to 29.1 miles due to database corrections on FR 6144D Bobtail Face D (0.1 mi) to reflect where the gate is located, and on FR 4698A (0.1 mi) to reflect where the berm is located, (no changes occurred on the ground), and the update to document the existing 0.7 miles of open route associated with powerline access not previously reported. BY 2019 open linear miles of road (31.4 miles) temporarily exceeds the BY 2019 baseline of 29.1 miles due to the user created motorized trail (1.21 miles) and breach on gated FR 14485 (1.09 miles).

RUA's established for Bear Year 2019

On January 25, 2020 an interagency group of biologists met to review credible grizzly bear sightings and update the existing BORZ database and BORZ areas (See Attachment 1). As a result of their review, it was determined that the Cedar Creek-Kootenai River and the Lower Pipe Creek 12th order HUC (formerly described as 6th order HUCS) met the recurring use criteria used in delineating the BORZ for the Access Amendment and were added as Recurring Use Areas (RUA's).

Cedar Creek – Kootenai River RUA

The existing condition established for total routes are 44.6 miles (consisting of 33.1 miles of KNF roads, 9.1 miles of long-term illegal user-created motorized routes, 0.8 miles of railroad tracks, and 1.6 miles of existing powerline access).

The 2019 BY total routes of 45.5 is temporarily 0.9 miles over the current database due to a breach on 0.3 miles of the non-motorized Whoop it up Trail, and 0.6 miles of an illegal user-created route to access the 567D spur). The barriers on these unauthorized trails will be reinforced in 2020.

The existing condition established for open routes are 32.4 miles (20.9 miles of open KNF roads in addition to the long-term illegal user-created motorized routes, railroad tracks and powerline access).

The 2019 BY open routes of 33.3 miles is temporarily 0.9 miles over the current existing condition due the increases described for total routes

The 1.6 miles of existing Bonneville Powerline access road that has received long-term illegal motorized use, and the 9.1 miles of existing long-term unauthorized illegal motorized user created trails out on the flats off of Pipe Creek Road are displayed in Table 10 as part of the existing

conditions for both open and total routes. The Libby Ranger District will be assessing the illegal routes in future analysis.

Lower Pipe RUA

The existing condition established for total routes are 87.5 miles (consisting of 86.4 miles of total KNF roads and 1.1 miles of long-term illegal user-created routes).

The existing condition established for open routes are 63.8 miles (62.7 miles of open KNF roads, and the 1.1 miles of long-term illegal user-created routes)

The 1.1 miles of long-term illegal unauthorized user-created motorized routes located on the flat area adjacent to Pipe Creek Road are displayed in Table 10 as part of the existing conditions for both open and total routes. The Libby Ranger District will be assessing these illegal routes in future analysis.

West Kootenai BORZ 2019 (2011 boundary and all additional RUA's)

The updated combined 2019 West Kootenai BORZ existing condition established for total routes are 790.1 miles and open routes are 456.9 miles**.**

The BY 2019 miles of open roads at 464.9 miles temporarily exceeds the 2019 456.9 miles as due to previously barriered or impassible routes being used for timber sale projects (under the Caribou or West Fork Fire Salvage projects or temporary breaches.

Specifics are as described above for the West Kootenai BORZ 2011 boundary, the additional Bobtail RUA (added 2012) and the Cedar Creek- Kootenai River and Lower Pipe RUA's added in 2019.

Tobacco BORZ

The KNF AA baseline of total and open linear miles of routes did not account for existing railroads or railroad access routes or existing powerline access routes. Previously reported bear year mileages also did not account for these routes. The KNF has no authority over these routes associated with the railroads and powerlines due to easements or other agreements. Unauthorized illegal motorized use is occurring on these routes. The 63.9 miles documented in 2019 are existing routes and no change on the ground.

The KNF updated the database and reset the Tobacco BORZ existing condition for total routes from 1,127.4 miles (BY2018) to 1,192.7 miles. This increase reflects database updates/corrections. FR 3668Y (0.3 mi) which reflects a change to an open road to access private driveway (falls under ANILCA). Database updates to FRs 7193A, 7976A, and 14940 to reflect ground condition of year-round gated roads – no access to public and no change on the ground. Database update to FR 7276 to reflect now gated access off highway to gravel pit. Road 4885I shows update in miles with better data from aerial photos, no change on ground. This also reflects the database updates for 63.9 miles of routes not previously considered (consisting of 22.4 miles of existing railroad tracks, 2.9 miles of railroad access roads, 26.9 miles of railroad dozerbladed firelines, and 11.7 miles of powerline access routes).

The KNF updated the database and reset the Tobacco BORZ existing condition for open routes from 872.0 miles (BY2018) to 936.4 miles. This increase reflects database updates/corrections. FR 3668Y (0.3 mi) changed to an open road to access private driveway (falls under ANILCA). FR 7981 (0.43) reflects a database correction that updates the gate location – no change occurred on the ground, and FR 7978 is a database correction for 0.05 miles to private driveway (ANILCA) that has always been open. Also included were database updates do document the 63.9 miles of open routes not previously considered (consisting of 22.4 miles of existing railroad tracks, 2.9 miles of railroad access roads, 26.9 miles of railroad dozerbladed firelines, and 11.7 miles of powerline access routes).

Updating the BORZ database utilizing 2019 data

Wayne Kasworm, Grizzly Bear Biologist with the US Fish and Wildlife Service, compiles agency data on potential sightings of grizzly bears and their sign, as well as known captures and mortalities in the Cabinet-Yaak and Selkirk Recovery Zones. This information is used to update the sightings records database and to determine BORZ areas. Review of data through 2019 data for the BORZ areas was completed January 15, 2020, with the meeting notes included as Attachment 1.

Contributors

Jeremy Anderson	Shelly Anderson	Linda Bernhardt	Mike Borysewicz
Susan Chin	Jennifer Durbin	Heather Fuller	Kris Hennings
Sean Hill	Jenny Holifield	Kent Johnson	Lynn Johnson
Brett Lyndaker	Ed Morgan	Annora Nelson	Diane Probasco
Ray Vinkey	Dave Wrobleski	Barb Young	

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Durbin, J. 2020. Bear Year 2019 Monitoring Summary Report for the Idaho Panhandle National Forest portion of the Cabinet-Yaak/Selkirk Grizzly Bear Recovery Zone. Unpublished USDA Forest Service. Dated March 30th 2020. 11 pp.

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USDI Fish and Wildlife Service. 2011. Biological opinion on the Forest Plan amendments for motorized access management within the Selkirk and Cabinet-Yaak grizzly bear recovery zones on the Kootenai, Idaho Panhandle, and Lolo National Forests. Helena-Montana and Spokane-Northern Idaho Field Offices. Dated October 18, 2011. 227 pp.

USDA Forest Service. 2011. Record of Decision – Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones. Kootenai, Lolo, and Idaho Panhandle National Forests. Signed November 11, 2011. 68 pp.

Wrobleski, D. 2020. Response to request for information for 2019 bear year monitoring. April 15, 2020.

Attachment 1:

Annual Review of Grizzly Bear sightings outside the Selkirk and Cabinet-Yaak Recovery Zone,

Idaho Panhandle NF, Kootenai NF, and Lolo NF

Annual Review of Grizzly Bear sightings outside the Selkirk and Cabinet-Yaak Recovery Zones

Idaho Panhandle NF, Kootenai NF, and Lolo NF

Meeting Date: Wednesday, January 15, 2020, notes updated with follow-up information 02142020

Time: 11:00 to 1400

Facilitator: Jeremy Anderson, Kootenai NF Wildlife Biologist

Notetakers: J. Anderson, J. Holifield, E. Morgan

Location: KNF SO Conference Room

Participants:

USFWS: Wayne Kasworm (MT FWS, CYE Program Grizzly Bear Biologist)

Idaho Panhandle NF: Diane Probasco (Forest Wildlife Biologist) Brett Lyndaker (Bonners Ferry RD WiBio), Heather Fuller (Sandpoint RD WiBio)

Lolo NF: Dave Wrobleski (Plains/Thompson Falls RD WiBio)

Kootenai NF: Chad Benson (Forest Supervisor), Jeremy Anderson (Forest WiBio), Kenny Kendall (KNF Acting Resources Staff), John Carlson (KNF Forest Fish/Wildlife Program Manager), Jenny Holifield (KNF Minerals WiBio), Bryan Donner (Ksanka RD District Ranger), Lynn Johnson (Ksanka RD WiBio), Sean Hill (Troy RD WiBio), Ed Morgan (Libby RD WiBio) Barb Young (GIS Coordinator), Kent Johnson (Data Services Specialist GIS-Web); Steve Snell, Staff Officer, Cabinet RD Acting District Ranger; Gary Kedesh (Timber/Minerals Staff Officer SO); Janis Bouma (SO NEPA/Objections/Litigation).

Introduction

Jeremy Anderson, KNF Forest Biologist gave an overview of the objectives of the meeting to review Wayne Kasworm's data to see if any additional HUCs met the recurring use criteria.

Review of Criteria (see Appendix A, pg.12 from Allen 2011 for complete list and details of criteria used)

- Delineation
  - 6th order Hydrological Unit Codes (HUCs) located around Recovery Zone boundaries used to objectively delineate a boundary around a given set of bear observation data.
  - The current HUC dataset used in 2020 represents the hydrologic unit boundaries to the 12-digit (6th level) as identified by NRCS in 2013 and although the identifying number may have changed from those used in 2010, the majority of the HUCs have retained a similar boundary. The exception being some very small HUC's that were combined, or very large HUCs that were divided into two.
  - For this review, mistakes in HUC#s provided in 2010 are noted and corrected
- Grizzly Bear Data used for Classification
  - Types of observations (all grizzly bear data, regardless of the population source of individual bears, Observations of females with cubs weighted more heavily, generally three or more credible observations within the last 16 years (Allen 2011:pg 2), thus for the January 15, 2020 meeting, this would be within the range of 2004 through 2019 in individual HUC's
  - Some personal judgment is utilized when considering use, such as if the locations resulted from an augmentation bear only moving through the area heading home.

Datasets Considered for both the Cabinet Yaak and Selkirk Recovery Zones January 2020 Review

- U.S. Fish and Wildlife Service (USFWS) credible sightings (category 4[1] and 5[2]) for the last 48 years (1960-2019)[3].
- USFWS known mortality data (1950's – 2019)
- USFWS radio collared, VHF, and GPS data, and IDF&G radio collared and VHF information (1999-2009) for Selkirks[3].
- USFWS hair samples, corrals, rub trees, DNA
- Photos from various sources (USFWS, FS, private trail cam photo's submitted to FWS)

Dataset not available at the time of the meeting, but follow-up completed as of 02132020.

Montana Fish, Wildlife and Parks data for NCDE (radio telemetry and sightings) from the existing Tobacco BORZ west to Highway 2 was not available at the time of the meeting but.Lynn Johnson followed up with FWP Lori Roberts.

- A shapefile of all HUCs south of the Tobacco BORZ extending to Highway 2, bordered on the north by the Kootenai River was sent to FWP. FWP reviewed their data and provided information.
- 1 male used the area in 2012. He used HUCs: Thomson Lake/Thompson River; Pearson Reservoir/Pleasant Valley/Fisher River; Barnum Creek/Pleasant Valley/Fisher River; and Pleasant Valley Creek.
- The 2nd male used the area in 2006, but only used the Barnum Creek HUC and the Pleasant Valley Creek HUC.
- Both males are dead now.
- No other bear locations are in the HUCs we sent her except the augmentation bears, which data Wayne Kasworm has.
- And there were some locations on the edge of but not in the Upper Wolf creek HUC.
-

[1] Credible sighting where the researcher talked with the observer and had a relatively high level of confidence that it was a grizzly bear
[2] Documented sighting (e.g. trapping location, observation, photograph, video, or track—most often by USFWS, USFS, or MTFWP biologists)
[3] U.S. Fish and Wildlife Service data and IDFG data reviewed on site courtesy of W. Kasworm. Data is not on file with the Kootenai or Idaho Panhandle NFs.

CABINET-YAAK Recovery Zone

Table 1. Occupied 6th level HUCs (BORZ) surrounding the Cabinet-Yaak Grizzly Bear Recovery Zone on the KNF, January 15, 2020

BORZ and Bear Year HUC Added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020*		Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	**Number**	**Name**	**Number**		
Area west of Lake Koocanusa and north of Highway 2						
West Kootenai						
2010	Sink Creek	~~170101010402~~ 170101010202	Sink Creek	170101010901	Yes (incorrect HUC# provided in 2010, 170101010402 was Lower Grave Creek)	Yes
2010	Young Creek	~~170101010403~~ 170101010203	Young Creek	170101010902	Yes (incoorect HUC# provided in 2010, 170101010403 was Therriault Creek)	Yes
2010	Dodge Creek	~~170101010405~~ 170101010204	Dodge Creek	170101010904	Yes (incorrect HUC# provided in 2010 170101010405 was Indian Creek)	Yes
2010	Sullivan Creek	~~170101010406~~ 170101010206	Sullivan	170101010905	Yes (incorrect HUC# provided in 2010, 170101010406 was Tobacco River)	Yes
2010	Lake Koocanusa-Poverty Creek	~~170101010409~~ 170101010209	Poverty Creek-Lake Koocanusa	170101010908	Yes (Incorrect HUC# provided in 2010)	Yes & No
2010	Boulder Creek	~~170101010601~~ 170101010501	Boulder	170101011101	Yes (Incorrect HUC# provided in 2010, 170101010601 was Fivemile Cr)	Yes
2010	Upper South Fork Big Creek	~~170101010501~~ 170101010503	Upper South Fork Big Creek	170101011001	Yes (Incorrect HUC# provided in 2010, 170101010501 was Boulder Creek)	Yes
2010	Lower South Fork Big Creek	~~170101010502~~ 170101010504	Lower South Fork Big Creek	170101011002	Yes (incorrect HUC# provided in 2010, 170101010502 was Sutton Creek)	Yes
2010	Big Creek	~~170101010503~~ 170101010505	Big Creek	170101011003	Yes (incorrect HUC# provided in 2010, 170101010503 was Upper South Fork Big Creek)	Yes
2010	Lake Koocanusa-Gold Creek	~~170101010604~~ 170101010507	Gold Creek – Lake Koocanusa	170101011104	Yes (Incorrect HUC# in 2010 170101010604 was Warland Cr)	Yes
2010	Parsnip Creek	~~170101010605~~ (170101010508)	Geibler Creek – Lake Koocanusa	170101011106	Yes (Incorrect HUC# provided in 2010, 170101010605 was Cripple Horse Creek, and 170101010607 was Canyon Creek)	Yes
2010	Lake Koocanusa	~~170101010607~~ (170101010510)				
2010	Bristow Creek	~~170101010702~~ (170101010602)	Bristow Creek	170101011202	Yes (Incorrect HUC # provided in 2010, 170101010702 was Swamp Creek)	Yes
2010	East Fork Pipe Creek	~~170101010901~~ (170101010803	East Fork Pipe Creek	170101011401	Yes (incorrect HUC# provided in 2010, 170101010901 was Ross Cr)	Yes
2010	Upper Pipe Creek	~~170101010902~~ (170101010804	Upper Pipe Creek	170101011402	Yes (incorrect HUC# provided in 2010, 170101010902 was Stanley Cr)	Yes
2010	Upper Seventeenmile Creek	170101030303	Upper Seventeenmile Creek	170101030503	Yes,	Yes

BORZ and Bear Year HUC Added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020*		Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	Number	Name	Number		
2012	Bobtail Creek	~~170101011003~~ 170101010806	Bobtail Creek	170101011503	Yes (incorrect HUC# provided in 2010, 170101011003 was North Callahan Creek)	Yes
2019	Lower Pipe Creek	170101010903	Lower Pipe Creek	170101011403	Yes; Coming 5 year-old radio collared female, at least 4 different males using HUC in last several years, 3 males in recent times, and 3 other bears, 2 management and 1 augmentation bear.	Yes
2019	Kootenai River	170101010808	Cedar Creek-Kootenai River	170101011505	Yes, but will truncate the HUC. See conclusion. At least 3 different males in last 15 years, use of the area to cross Kootenai River by 2 males (#726, 722). In area of HUC identified as potential linkage, HUC is located both sides of Kootenai River- with portions in RZ in BMU10 on north side, and in BMU1 south side. The HUC south of the River, including the portion in the Recovery Zone to western edge of HUC outside RZ: record of use by 2 native males, and 4 augmentation bears, 2 males and 4 females, two of which stayed, 2 of which left. North of the River record of 3 males that have used the area, 1 peripherally and 2 that have spent time. Private land J Neils and south- no data on the private land J neils park and south to River. Portions of HUC to be Truncated: There are three small "arms" of the HUC south of the Kootenai River toward the eastern southern extent that will be truncated using the Kootenai River and not considered as part of the NFS ownership within the BORZ due to no data or Private ("arm" with KNF Skidale area, "arm" with town of Libby, and "arm" with the small island of KNF ownership in the middle of the Kootenai River.	Yes
	Barron Creek	~~170101010704~~ 170101010603	Barron Creek	170101011204	No, 1 or 2 males recent peripheral use, (Incorrect HUC# provided in 2010, 170101010704 was Big Cherry Creek)	No
	Jackson Creek	~~170101010706~~ 170101010606	Jackson Creek	170101011206	No (incorrect HUC# provided in 2010)	No
	Lake Koocanusa-Little Jackson Creek	~~170101010708~~ 170101010608	Little Jackson Creek-Lake Koocanusa	170101011208	No (Incorrect HUC# provided in 2010)	No
	Rainy Creek	170101010710	Rainy Creek	170101011210	No, 2003 sighting, more recent use of bear crossing KNF but not enough to meet criteria	No

BORZ and Bear Year HUC Added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020*		Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	Number	Name	Number		
	Upper Kootenai River	170101010711	Mitchell Creek-Kootenai River	170101011211	No, More recently use or travel by augmentation bear, male bear #726, and #726 resident male. Not enough of criteria met	No
General Area located East of Lake Koocanusa						
Tobacco						
2010	Swamp Creek-Lake Creek	170101010201	Lake Creek-Swamp Creek	170101010701	Yes	Yes
2010	Upper Fortine Creek	170101010202	Upper Fortine Creek	170101010702	Yes	Yes
2010	Sunday Creek	170102100102	Sunday Creek	170102100102	Yes	Yes
2010	Upper Stillwater River-Hellroaring Creek	170102100103	Hellroaring Creek-Stillwater River	170102100103	Yes	Yes
2010	Edna Creek	170101010203	Edna Creek	170101010703	Yes	Yes
2010	Middle Fortine Creek	170101010204	Middle Fortine Creek	170101010704	Yes	Yes
	Deep Creek	170101010205	Deep Creek	170101010705	HUC is all PVT land outside of recovery area.	No
2010	Meadow Creek	170101010206	Meadow Creek	170101010706	Yes	Yes
2010	Lower Fortine Creek	170101010207	Lower Fortine Creek	170101010707	yes	Yes
	Lower Grave Creek	170101010302	Lower Grave Creek	170101010802	Two-thirds of HUC in Recovery; only 5% of rest in FS in-holdings.	No
	Therriault Creek	170101010303	Therriault Creek	170101010803	One third of HUC in RZ; FS has small in-holdings surrounded by PVT	No
	Sinclair Creek	170101010304	Sinclair Creek	170101010804	One-half of HUC is in RZ; half in PVT, except for small FS in-holdings	No
	Indian Creek	170101010305	Indian Creek	170101010805	HUC is all PVT land outside of recovery area.	No
2010	Tobacco River	170101010306	Tobacco River	170101010806	Yes	Yes
	Phillips Creek	170101010404	Phillips Creek	170101010903	85-90% of HUC is PVT. Small portion of FS along reservoir/border in PPine habitat. FS portion in unroaded mgmt.	No
2010	Upper Pinkham Creek	170101010407	Upper Pinkham Creek	170101010906	Yes	Yes
2010	Lower Pinkham Creek	170101010408	Lower Pinkham Creek	170101010907	Yes	Yes
2010	Sutton Creek	170101010602	Sutton Creek	170101011102	Yes	Yes
2010	McGuire Creek	170101010603	McGuire Creek	170101011103	Yes	Yes
2010	Tenmile Creek	170101010606	Tenmile Creek	170101011105	Yes	Yes
2010	Fivemile Creek	~~170101010701~~ 170101010601	Fivemile Creek	170101011201	Yes, also linkage (incorrect HUC in 2010 meeting notes 170101010701 was Upper Libby Creek	Yes
	Warland Creek	170101010703	Warland Creek	170101011203	No	No

BORZ and Bear Year HUC Added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020*		Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	**Number**	**Name**	**Number**		
	Cripple Horse Creek	170101010705	Cripple Horse Creek	170101011205	Recently have had a young CYE bear that spent time in Cripple Horse and Upper Sunday but not enough recent occurrences to meet all criteria	No
	Canyon Creek	170101010707	Canyon Creek	170101011207	No	No
	Weigel Creek	170101020301	Weigel Creek	170101020301	No	No
	Upper Wolf Creek	170101020302	Upper Wolf Creek	170101020302	No	No
	Dry Fork Creek	170101020303	Dry Fork Creek	170101020303	No	No
Area south and West of Highway 2						
Cabinet Face						
2010	Swamp Creek-Cowell Creek	~~170101010802~~ 170101010702	Cowell Creek-Swamp Creek	170101011302	Yes, No use west of Hwy 2—cut HUC off at highway due to lack of sightings and lack of habitat.(HUC# incorrectly identified in 2010 as 170101010802, Parmenter Cr)	Yes
	Granite Creek	~~170101010802~~ 170101010703	Granite Creek	170101011303	No (HUC# previously provided 170101010802 was incorrect)	No
2010	Big Cherry Creek	~~170101010804~~ 170101010704	Big Cherry Creek	170101011304	Yes also attractants and sanitation issues (HUC# incorrectly identified in 2010 as 170101010804 was Upper Pipe Creek)	Yes
2010	Upper Libby Creek	~~170101010801~~ 170101010701	Upper Libby Creek	170101011301	Yes (HUC# incorrectly identified in 2010 as 170101010801 which was Flower Creek)	Yes
2010	Lower Libby Creek	~~170101010805~~ 170101010705	Lower Libby Creek	170101011305	Yes. (HUC# incorrectly identified in 2010 as 170101010805 Lower Pipe Creek). 2020 Discussion centered on remaining portion of the HUC east of the highway. Historic use by female #258, 1992 augmented female, 3 different males all in last 5-7 years using it as part of home range or on periphery of their range, from linkage standpoint HUC is along highway, value for connectivity, # of males cross here, one is traveling peripheral. Much of use on private land, seasonality with spring getting down low, fall use is getting into carcasses dumped in woods. Bear #770 got into a building with elk carcass. Selkirk bear crossed and hung out here on a carcass by Fish Hatchery Multiple use of bears in last 5-7 years, radio collared data, have recurring use in adjacent hucs. But if take away private land, very scattered use on NFS. Not sure if corridor activity is increasing on private land, or are attractants bringing bears into private land. Will closely monitor HUC east of Highway 2 to see if more use is occurring on NFS, currently recurring use on NFS land east of highway 2 does not meet criteria, so will not add that portion	Yes[1] And No

BORZ and Bear Year HUC Added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020*		Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	Number	Name	Number		
					of the HUC in at this point in time. Relook closely end of 2020.	
	Flower Creek	~~170101011001~~ 170101010801	Flower Creek	170101011501	No, relook at HUC closely in 2020 due to recent use (male bear #726) (HUC# incorrectly identified in 2010 as 170101011001 Obrien Creek	No
	Parmenter Creek	~~170101011002~~ 170101010802	Parmenter	170101011502	No (HUC# incorrectly identified in 2010 as 170101011002 which was South Callahan Creek)	No
2019	Middle Kootenai River	~~170101011005~~ 170101010808	Cedar Creek-Kootenai River	170101011505	Yes, Most of HUC in RZ. (HUC# incorrectly identified as #170101011005 in 2010, which was Ruby Creek). HUC also listed under West Kootenai Borz. HUC not adjacent to active HUC in Cabinet Face, but is adjacent to HUCs in West Kootenai Borz.	Yes
	Island Creek	170101020102	Island Creek	170101020102	No	No
	Pleasant Valley Creek	170101020103	Pleasant Valley Cr	170101020103	No	No
	Pleasant Valley Fisher River-Pearsons Reservoir	170101020104	Pearson Reservoir-Pleasant Valley Fisher River	170101020104	No	No
	Pleasant Valley Fisher River-Barnum Creek	170101020105	Barnum Creek-Pleasant Valley Fisher River	170101020105	No	No
	Elk Creek	170101020106	Elk Creek	170101020106	No (HUC# provided in 2010 would have been #170101020201 if was reflecting 2010 6th code HUC)	No
	McGinnis Creek	170101020107	McGinnis Creek	170101020107	No (HUC # provided in 2010 would have been #170101020202 t if using 2010 6th code HUC)	No
	Pleasant Valley Fisher River-	170101020108	Loon Lake-Pleasant Valley Fisher River	170101020108	No (HUC# provided in 2010 would have been #170101020401 if was reflecting 2010 6th code HUC)	No
	East Fisher Creek	170101020201	East Fisher Creek	170101020201	No (HUC# provided in 2010 would have been #170101020203 if was reflecting 2010 6th code HUC)	No
	Silver Butte Fisher River	~~170101020202~~ 170101020204	Silver Butte Fisher River	170101020202	No (HUC # provided in 2010 was incorrect, 170101020202 was for McGinnis Creek in 2010)	No
	Little Wolf Creek	170101020304	Little Wolf Creek	170101020304	No	No
	Middle Wolf Creek	170101020305	Middle Wolf Creek	170101020305	No	No
	Lower Wolf Creek	170101020306	Lower Wolf Creek	170101020306	No	No
	Dunn Creek	~~170101010709~~ 170101010609	Dunn Creek	170101011209	No (HUC # provided in 2010 Level 1 meeting notes was incorrect)	No
2010	West Fisher Creek	~~170101020401~~ 170101020205	West Fisher Creek	170101020401	Yes (Most of HUC in RZ where historic and recent use is documented) (HUC # provided in 2010 was incorrect as 170101020401 was for Pleasant Valley Fisher River)	Yes

BORZ and Bear Year HUC Added	**6th Order HUC 12/10/2010 (Allen 2011)***		**12-digit to the 6th Level HUC 2020***		**Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)**	**Recurring Use Area Yes or No?**
	Name	**Number**	**Name**	**Number**		
2010	Fisher River	170101020402	Upper Fisher River	170101020402	Yes, HUC cut off at Hwy 2 due to lack of sightings and habitat on east side of Hwy	Yes
	McKillop Creek	170101020403	McKillop Creek	170101020403	No	No
	Cow Creek	170101020404	Cow Creek	170101020404	No	No
	Fisher River	170101020405	Middle Fisher River	170101020405	No, observations in 1993, 2007, 2009, and 2018. Augmentation make mostly, but 2 males spending a portion of their time here. The male who went to Sunday Creek and back to Cabinets used this HUC, so a couple of male bears that are going back and forth, criteria not quite met as of bear year 2019	No
	Lower Fisher River	170101020406	Lower Fisher River	170101020406	No	No
	McGregor Creek	170102130101	McGregor Creek	170102130101	No	No
	Thompson Lakes	170102130102	Thompson Lakes-Thompson River	170102130102	No	No
	Lower Kootenai River	~~170101011207~~ 170101011007	Brush Creek-Kootenai River	170101011707	No (HUC# provided in 2010 was incorrect)	No
	Radio Creek	170102130401			Lolo NF	
	Upper Fishtrap Creek	170102130402			Lolo NF	
	Upper Vermillion	170102130801			Lolo NF	
Area located to the southwest of Highway 200 and the Recovery Zone						
Clark Fork						
	Upper Big Beaver Creek	170102130701	Upper Big Beaver Creek	170102130701	No (HUC# in 2010 was actually HUC6 170102130801)	No
	Little Beaver Creek	170102130702	Little Beaver Creek	170102130702	No (HUC# in 2010 was actually HUC 6 170102130802	No
	White Pine Creek	170102130703	White Pine Creek	170102130703	No (HUC# in 2010 was actually HUC6 170102130803)	No
	Lower Big Beaver Creek	170102130704	Lower Big Beaver Creek	170102130704	No (HUC# in 2010 was actually HUC6 170102130804)	No
	Lower Vermilion River	170102130803	Lower Vermilion River	170102130803	No	No
	Graves Creek	170102130701	Graves Creek	170102130901	No, Lolo NF,	No
	Deep Creek	170102130903	Deep Creek	170102130903	No sightings outside RZ (HUC # in 2010 was actually #170102130703	No
	Noxon Reservoir-Mosquito Creek	170102130904	Mosquito Creek-Noxon Reservoir	170102130904	No (HUC # in 2010 was actually HUC6 170102130704)	
	Noxon Reservior-Bear Creek	170102130905	Bear Creek Noxon Reservoir	170102130905	No sightings outside RZ (HUC# in 2010 was actually HUC6 170102130705 and was called Clark Fork River	No
	Upper Trout Creek	170102131001	Upper Trout Creek	170102131001	No (HUC# in 2010 was actually HUC6 170102130901)	No
	Lower Trout Creek	170102131002	Lower Trout Creek	170102131002	No (HUC# in 2010 was actually HUC6 170102130902	No
	Noxon Reservoir-Belgian Gulch	170102131003	Belgian Gulch-Noxon Reservoir	170102131003	No (HUC# in 2010 was HUC6 170102130807 for Noxon Reservoir)	No

BORZ and Bear Year HUC Added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020*		Grizzly Bear Use Criteria Met? Yes or No? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	**Number**	**Name**	**Number**		
2010	Marten Creek	170102131004	Marten Creek	170102131004	Yes (HUC# in 2010 was actually HUC6 170102130903)	Yes
2010	Noxon Reservoir-Stevens Creek	170102131006	Stevens Creek-Noxon Reservoir	170102131006	Yes (HUC# in 2010 was HUC6 170102130905 for Noxon Reservoir	Yes
2010	Pilgrim Creek	170102131302	Pilgrim Creek	170102131302	Yes (HUC # in 2010 was actually HUC6 170102131102	Yes
2010	Upper Cabinet Gorge Reservoir	170102131303	Upper Cabinet Gorge Reservoir	170102131303	Yes (HUC# in 2010 was HUC6 170102131108 for Cabinet Gorge Reservoir	Yes
2010	East Fork Elk Creek	170102131304	East Fork Elk Creek	170102131304	Yes (HUC# in 2010 was HUC6 170102131103	Yes
2010	Elk Creek	170102131305	Elk Creek	170102131305	Yes	Yes
2010	Lower Cabinet Gorge Reservoir	170102131306	Lower Cabinet Gorge Reservoir	170102131306	Yes	Yes
	Clark Fork River Cabinet Gorge Dam	17010213309	Cabinet Gorge Dam-Clark Fork	170102131309	No, IPNF	No
Area located around Troy – Troy Polygon						
			Obrien Creek	170101011701		
			Brush Creek	170101011707		

[1]Areas east of Highway 2 within these HUCs have issues related to a higher level of private property and residences with sanitation issues

Table 2. Occupied 6th level HUCs (BORZ) surrounding the Cabinet-Yaak Grizzly Bear Recovery Zone on the IPNF, January 15, 2020

BORZ And Bear Year HUC added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020**		Grizzly Bear Use Criteria Met? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	**Number**	**Name**	**Number**		
Area northwest of the Recovery zone that is located north and east of Kootenai River						
Mission Moyie						
2010	Mission Creek	170101040508	Mission Creek	170101040707	Yes	Yes
2010	Kootenai Valley	170101040501	Hall Creek – Kootenai River	170101040711	Yes	Yes
2010	Round Meadows Creek	170101050303	Round Meadows Creek	170101050501	Yes	Yes

BORZ And Bear Year HUC added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020**		Grizzly Bear Use Criteria Met? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	Number	Name	Number		
2010	Moyie River above Feist Creek	170101050203	Copper Creek-Moyie River	170101050403	Yes	Yes
2010	Moyie River above Placer Creek	170101050301	Kreist Creek-Moyie River	170101050502	Yes	Yes
2010	Kootenai Valley	170101040501	Whiskey Creek-Kootenai River	170101040712	Yes, Small portion of this HUC in the United States	Yes
2016	Kootenai Valley	170101040501	Brush Creek-Kootenai River	170101040708	Yes, Truncated at Hwy 95	Yes
2016	Kootenai Valley	170101040501	Rock Creek-Kootenai River	170101040706	Yes, Truncated at Hwy 95	Yes
2016	Meadow Creek	170101050304	Meadow Creek	170101050503	Yes, truncated at roughly Meadow Creek using Meadow Cr Road and NFS boundary,	Yes
2016; 2019	Lower Moyie River	170101050306	Skin Creek-Moyie River	170101050505	No data in 2010, in 2016 met criteria and truncated where the HUC6 intersects the Moyie River at the mouth of Deer Creek. For BY 2019 IPNF proposes to turn on the remainder of the HUC EAST of the Moyie River only. Portions of the HUC have provided adult female with young, Female from Canuck Creek mortality, additional males, and another 2 bears not known to be dead.	Yes, and no
2016	Deer Creek	170101050308	Deer Creek	170101050504	2010 did not meet criteria; 2016 met Criteria	Yes
2019	Curley Creek	170101040103	Curley Creek	170101040202	Yes, turn on IPNF-administrated lands north of the Kootenai River.	Yes
	Pine Creek	170101040102	Pine Creek	170101040201	No	No
	Kootenai River above Bonners Ferry	170101040101			Incorrect code listed in 2010 notes, this is HUC61701010403 in 2010, which was also described separately and now split into Dawson Lake, cabin Cr-Cow, Dobson Creek and Sand Creek Kootenai River described below	
2019	Kootenai R above Sand Cr	170101040301	Sand Creek – Kootenai River	170101040301	Yes, turn on IPNF-administrated lands north of the Kootenai River.	Yes
2019	Kootenai R above Dobson Cr	170101040302	Dobson Creek-Kootenai Rver	170101040302	Yes, turn on IPNF-administrated lands north of the Kootenai River, (use of area by female bear is on private).	Yes
	Kootenai River above Cow Cr	170101040303	Cabin Creek-Cow Creek	170101040303	No	No
	Kootenai River above Bonners Ferry	170101040304	Dawson Lake-Kootenai River	170101040304	No	No
	Brown Creek including Twentymile Creek	170101040406	Twentymile Creek	170101040404	No	No

BORZ And Bear Year HUC added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020**		Grizzly Bear Use Criteria Met? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	Number	Name	Number		
	Deep Creek above Brown Creek	170101040402	Trail Creek-Deep Creek	170101040403	No	No
	Rapid Lightning Creek	170102140506	Rapid Lightning Creek	170102140105	Most of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary	No
	Grouse Creek	170102140505	Grouse	170102140104	Most of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary	No
	Lower Pack River	170102140504	Lower Pack River	170102140106	Portions of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary.	No
	Strong Creek	170102140401	Lake Pend Oreille	170102140206	Most of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary.	No
	Lightning Cr below EF Lightning Creek	170102131304	Lower Lightning Creek	170102131204	Most of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary.	No
	Lower Clark Fork at mouth	170102131204	Johnson Creek Clark Fork River	170102131310	Portion of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary.	No
	Lower Clark Fork below Cabinet Gorge	170102131201	Johnson Creek-Clark Fork River	170102131310	Most of this HUC is in the RZ; no other sightings at lower elevations outside of the RZ boundary.	No
			Cabinet Gorge Dam-Clark Fork	170102131309	Most of this HUC is in the RZ	No
			Twin Creek	170102131308	Outside of RZ	No

SELKIRK Recovery Zone

Table 3. Occupied 6th order HUCs (BORZ) surrounding the Selkirk Grizzly Bear Recovery Zone, IPNF, Updated January 15, 2020

BORZ and Bear Year HUC added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020**		Grizzly Bear Use Criteria Met? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	Number	Name	Number		
Area to the west of Priest Lake and Priest River and south of KalispellGranite, LeClerc, and Lakeshore BMUS						
Priest						
	Lower Granite	170102150303	Blacktail Creek-Granite Creek	170102150203		No
	Reeder	170102150206	Reeder	170102150303		No
2010	Reeder (Reynolds Cr)	170102150206	Reeder	170102150303		Yes*
2010	Kalispell	107102150208	Kalispell	170102150306	Truncated Hwy 57	Yes*
2010	Priest Lake Riparian	170102150201	Priest Lake	170102150309	Truncated at hwy 57	Yes
2010	Lamb Creek	170102150401	Lamb	170102150308	Truncated Hwy 57	Yes*
	Priest River below Outlet Bay including Binarch Creek	170102140402	Binarch Creek-Priest River	170102150701	As of 2019, 2 different males (5 years of data) using, would truncate at hwy 57, Current use not meeting criteria, relook at closely after 2020	No
2010	Upper W. Branch below Solo Creek	170102150502	Mission Falls-Upper West Branch Priest River	170102150403	Yes	Yes
	Priest Lake East Face (NFS)	170102150502			2020 note is this # from 2010 is same as one above	No
2010	Upper W. Branch above Solo Creek	170102150501	Headwaters Upper West Branch Priest River	170102150401	Yes	Yes
2010	Goose Creek	170102150503	Goose Creek	170102150402	Yes	Yes
2010	Lower W. Branch above Flat Cr	170102150701	Flat Creek-Lower West Branch Priest River	170102150602	Yes, in part. Based on observations through 2019, current HUC boundary truncated just north of Mosquito Creek,	Yes, and No
	Upper W. Branch below Flat Cr	170102150702	Pine Creek-Lower West Branch Priest River	170102150603	No	No
	Priest River above East River	170102150403	Murray Creek-Priest River	170102150702	No	No
	Moore's Creek	170102150703	Moores Creek	170102150601	2 bears, both males, one from a bear that maybe just passing through from almost ten years ago, one more recent, multiple and maybe peripheral use to its home range, one mortality from back in 1982. Adjacent HUC Flat Creek-lower west branch #170102150602turned on in 2010. Currently Moores HUC not meeting criteria, relook closely in 2020.	No

BORZ and Bear Year HUC added	6th Order HUC 12/10/2010 (Allen 2011)*		12-digit to the 6th Level HUC 2020**		Grizzly Bear Use Criteria Met? (as of data through 2019)	Recurring Use Area Yes or No?
	Name	**Number**	**Name**	**Number**		
	Lower Pend Oreille River	170102150406			See HUC below	No
	Lower Priest River	170102150406	Sanborn Creek-Priest River	170102150705	No	No
	Big Creek	170102150404	Big Creek-Priest River	170102150703	No	No
	Priest River below Big Creek	170102150405	Quartz Creek-Priest River	170102150704	No	No
	Priest Lake East Face (NFS)	170102150502				No
	Middle Fork East River	170102150601	Middle Fork East River-East River	170102150502	No	No
	North Fork East River (NFS)	170102150603	North Fork East River	170102150501	No	No
Area located between the south eastern corner of the Recovery Zone and Highway 95						
Pack River						
2010	Pack River above Caribou Creek	170102140201	Headwaters Pack River	170102140101	Yes	Yes
2010	Pack River above Jeru Creek	170102140201			Yes	Yes
2010	Deep Creek above McArthur Lake outlet	170101040401	Deep Creek-McArthur Lake	170101040401	Yes	Yes
2010	Fall Creek	170101040403	Fall Creek	170101040402	Yes	Yes
2010	Soldier Creek (NFS lands)	170102150210	Soldier Creek	170102150307	Yes	Yes
	Pack River above Sand Creek	170102140503	Upper Pack River	170102140102	No	No
			Middle Pack River	170102140103	No	No
	Deep Cr abov Brown Creek	170101040402	Trail Creek-Deep Creek	170101040403	No	NO
2019	Myrtle Cr	170101040502	Myrtle Creek	170101040701	Yes, Most in RZ, small bit outside,	*Yes*
2019	Deep Cr below Brown Creek	170101040405	Caribou Creek-Deep Creek	170101040406	Yes, Upper in RZ. Ruby Creek mostly private, locations on private. As of 2019 Caribou HUC radio collared female use, # of different males, DNA hits, photos of bears and females with cubs.	*Yes*
2019	Caribou Cr	170101040407				
2019	Ruby Cr	170101040404				
2019	Snow Creek	170101040408	Snow Creek	170101040405	Yes, Upper end in RZ where have observations, (females, multiple bears) and most data within the RZ. HUC is surrounded by active HUCs in the BORZ.	*Yes*

January 2020
GIS SOURCES
***For 2010 HUC number verification**
T:\FS\NFS\R01\Collaboration\KIPZForestPlan\GIS\FPR00\coverages\ipnf\water\huc6 to Correct the 2010 HUC Numbers
T:\FS\NFS\Kootenai\Program\2600Wildlife\GIS\SO\Data\BORZ\KNF_BORZ_2010\knf_borz_0710.mdb\Feature Class: knf_huc_6
****For 2020 HUC Number and Name**
T:\FS\Reference\EDW\Hydrology_WBD_WatershedBoundaryDatabase_USGS_EDW.lyr.
\(Hydrology_USGS_WatershdBoundaryDatabase_WBDHU12

Additional Brief Summary of Notes from the Meeting in addition to what is contained in the previous Tables

Lolo NF

Thompson River
Two male bears and two sightings.
One of the bears was a young male from the Selkirks, spent the summer -3 months in the Thompson River, and back and forth to the Fisher until he lost his collar.
The other bear is peripheral use.
Other sighting can tie in to radio collar. Are not sure all the dots constitute 2 male bears and some peripheral use. Use scattered from Chain of Lakes down to Thompson River. No collared female use. A couple of dots on the screen are augmentation bears heading north toward home. At the south end some of the dots on the screen are Selway bear coming home.

Are seeing more use in BMU22, but not enough use yet to justify turning on the Thompson River HUC

KNF

Tobacco BORZ

Some of what we see on the screen are augmented bears heading home. Some are not augmentation bears, are spending time. Really only 2 male bears that currently fit the criteria. Based on follow-up with NCDE, currently not enough recurring use to turn on additional HUCS.